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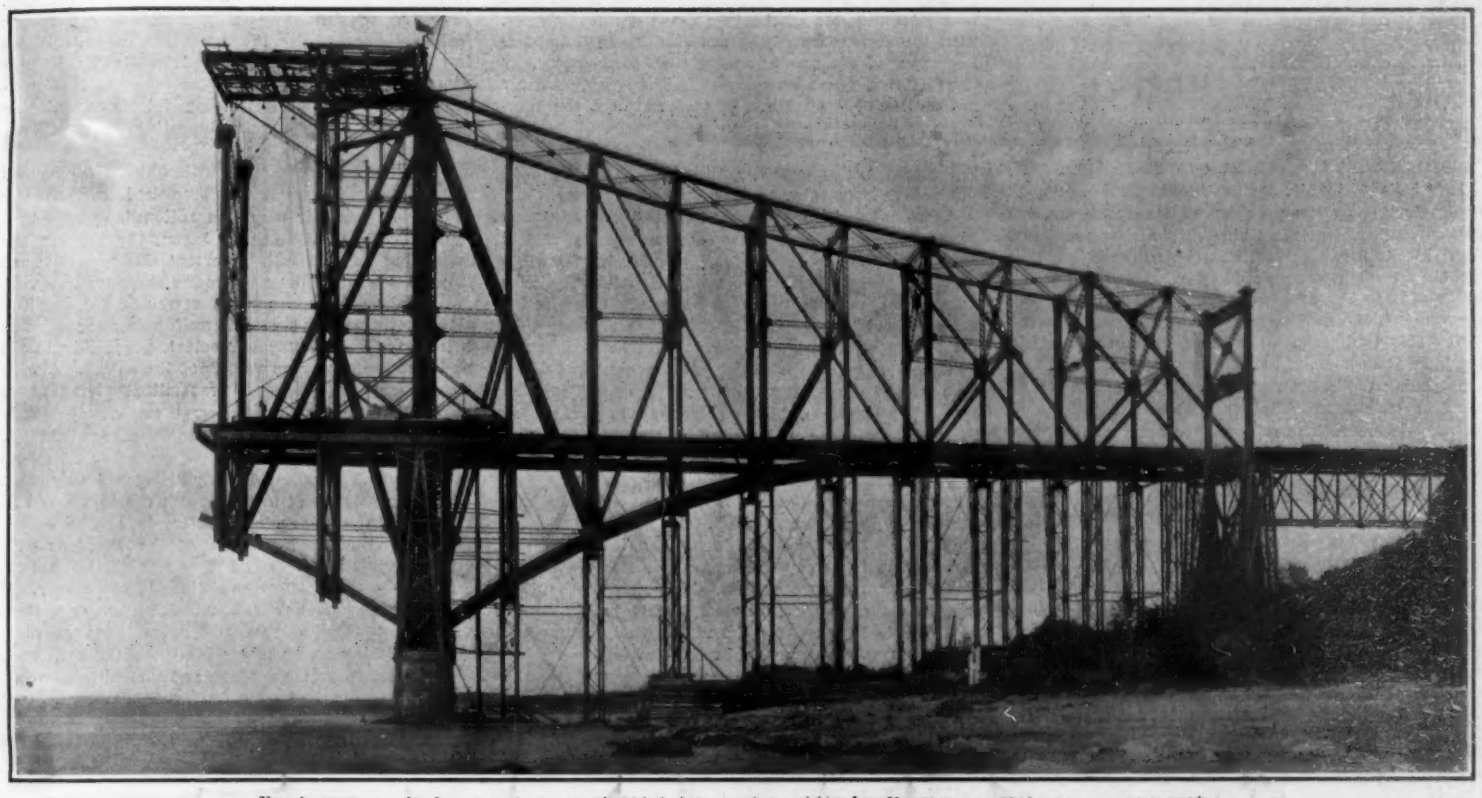
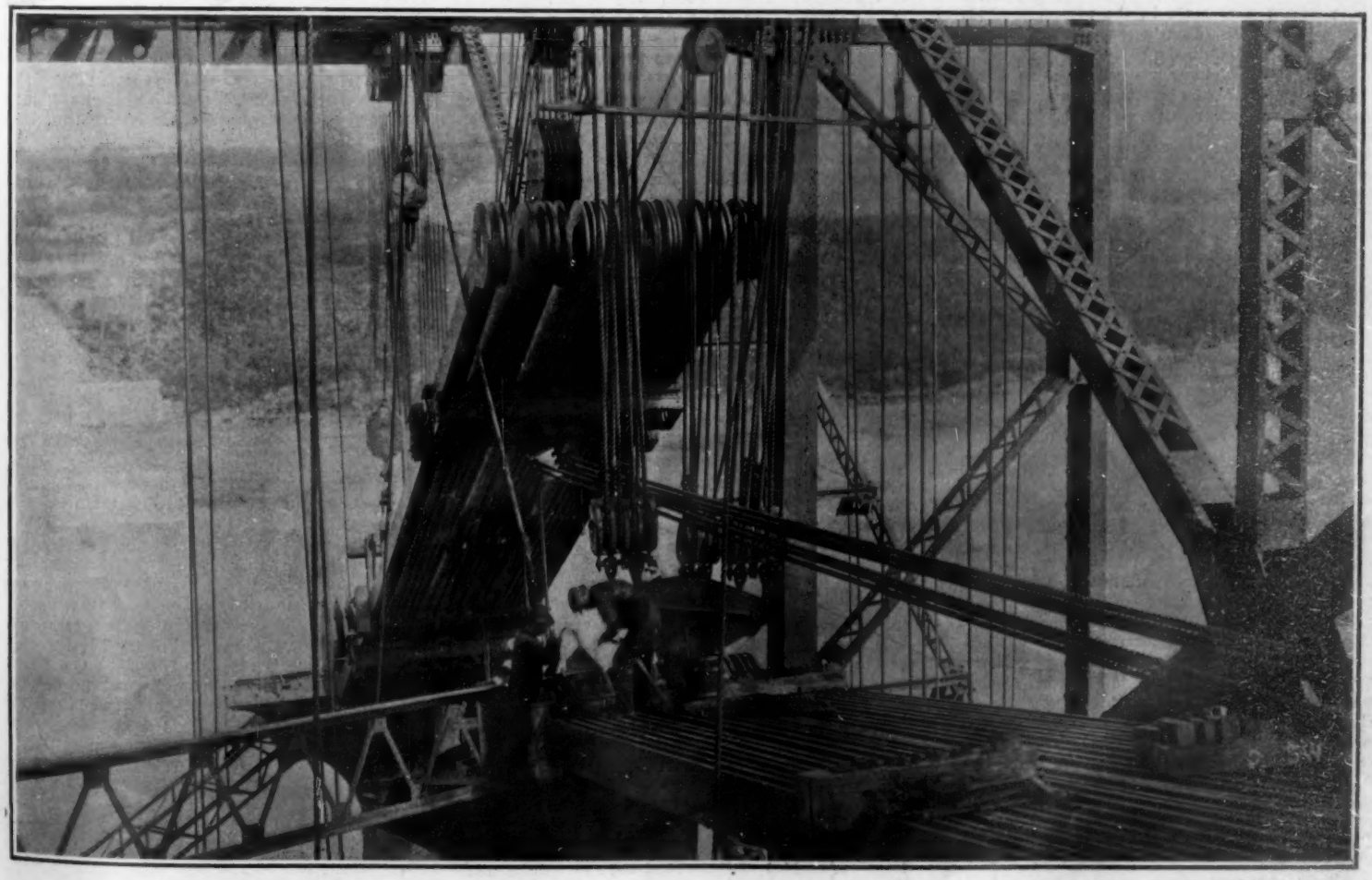


Note the erecting traveler, from the projecting arm of which the heavy members, weighing from 80 to 90 tons, are lifted and swung out into position.

Side View of the Completed South Anchor Arm and Two Panels of the Cantilever Arm.



The set of eyebars on which men are standing is in position and forms the chord of the first panel. The suspended set is being slung into position by tackles attached to projecting arm of the traveler.

Connecting the Second Upper Floor Panel of the Cantilever Arm.

ERECTING THE QUEBEC BRIDGE—THE LONGEST-SPAN BRIDGE EVER BUILT.—[See page 228.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, SEPTEMBER 29, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

AGRICULTURE THE TRUE SOURCE OF OUR WEALTH.

It is believed by Mr. James J. Hill, whose life work of developing, by the provision of transportation, the unoccupied lands of the United States, has peculiarly fitted him to speak authoritatively on the subject, that the most serious economic question of the future will be to provide the food supply of the 200,000,000 people who will be seeking for homes and work in the United States by the time the present century has run half its course. In the course of an address at the opening of the Annual Agricultural Exposition of the Minnesota State Fair Association, Mr. Hill stated that no nation in history was ever confronted with a more pressing question than that of providing for the 50,000,000 of additional population which, within the next twenty years, must be housed and given employment; furthermore, he believes that the one and only adequate resource before us is the productivity of the soil. In solving the problem, the first fact which must be brought home is that of our dependence upon the cultivation of the soil; for Mr. Hill considers that agriculture, in the most intelligent and comprehensive meaning of the term, is something almost unknown in the United States. The government estimate of the value of all farm products last year was $6,415,000,000, which, after it had been discounted for high prices and current favorable conditions, would be represented by an average total of about $5,000,000,000. Government statistics also state that of the lands taken up in the United States, a little less than one-half is under cultivation. Were the other half utilized the output of the soil would be practically doubled, even if no change were made in the present methods of cultivation. But by directing surplus population, not, as now, so largely into the cities, but to the soil, and by the adoption of the advanced methods of cultivation used elsewhere, the present minimum yield would be so largely increased, that we could add ten billion or even fifteen billion dollars to the national wealth.

The methods by which the yield of the soil could be increased are three, and they are well known though but little practised. First is the rotation of crops, which is so little followed that the majority of our farmers have been raising, year after year, the same crops on the same land, until the soil is all but exhausted. The second method of increasing the yield is the liberal use of fertilizing material, and the third and most interesting of all is better tillage.

As showing what intensive cultivation will do, Japan is quoted as supporting 45,000,000 of people on ten thousand cultivated square miles, aided by the food products obtained from the sea; while a market gardener of Paris is quoted as declaring that all food, animal and vegetable, required for 3,500,000 people of two great departments of that city could be grown by methods already in use on the 3,250 square miles of garden surrounding the city.

What is needed is a return to conservative and economic methods, a readjustment of national ideas which will place agriculture in the very forefront. The present tendency to regard manufacture and trade as the only forms of progressive activity, and the false notion that riches can be built upon these at the sacrifice of the fundamental form of wealth production, must give way to a recognition of the fact, once so well understood, that the soil is the foundation of all wealth and prosperity. Acknowledgment of this principle will have the double advantage of vastly increasing the agricultural output of the country, and at the same time of checking that deplorable migration from the country to the city, which has lowered the percentage of agricultural labor to the whole body of persons engaged in gainful occupations in the United States from 44.3 in 1880 to 35.7 in 1900.

A SUGGESTED CURE OF GUN EROSION.

We direct attention to a letter on gun erosion published in another column from a correspondent who disagrees with the position taken in our editorial of September 15, in which we stated that the erosion is probably due to the escape of gases past the base of the projectile. Our correspondent is of the opinion that erosion is due to the fusion of the metal of the bore by the great heat of the powder gases, and his argument will well repay the perusal. While we are not prepared to state that this cause plays no part whatever in erosion, we are still of the opinion that the major part of the damage is due to what we may call the abrading effect of the white hot gases moving at enormous velocities past the projectile. We are well aware that our suggested remedy of providing more perfect sealing at the base of the shell is not by any means new; but we are inclined to believe that the failure of previous attempts has been due to the incomplete or inadequate means employed, rather than to a misconception of the true cause of the difficulty. That the destruction of the metal is due to the abrading effect of the gases is suggested, furthermore, by the fact that where leaks occur in the compressed air mechanism of the torpedo, it is found that the enormous velocity of the escaping air cuts away the metal, gradually enlarging the orifice. The fact that erosion is present throughout the full length of the bore (though in decreasing amount toward the muzzle) is due, we believe, to the fact that the copper rifling band, as now made, is too small, too narrow, for its work. If a band 50 per cent, or even 75 per cent wider than the present band were used in conjunction with a suitable obturating pad at the base of the projectile, the pad would prevent the initial escape of gases until the rifling band had been driven well home into the rifling, after which the larger band would, we believe, take care of the gases until the projectile had left the gun. The question, however, cannot be decided by theorizing on paper, and we believe that it would well repay the cost of thorough experimental investigation at the proving ground.

The suggestion of our correspondent that the best solution of the difficulty lies in the use of high-speed steel for the material of the inner tubes is well worthy of consideration, and we commend it to the investigation of our ordnance experts. No objection could be raised on the ground that steel of this quality would be liable to fracture, for the reason that the method of building modern guns, either by shrinking on hoops or winding on wire under great tension, throws the tube into a state of initial compression so great that even the powder pressures are unable to overcome it, and the tube is never, at least in the wire-wound guns, subjected to a tensional stress. The cost of making a test on a gun of small caliber would not be great, and in view of the rapid loss of accuracy and short life of modern breech-loading guns, the higher cost of the high-speed steel would probably not be found to be an insuperable objection to its use.

WIRELESS TELEGRAPHY AND TELEPHONY IN THE JAPANESE NAVY.

A representative of the SCIENTIFIC AMERICAN was recently accorded the privilege of an interesting talk with Dr. Shunkichi Kimura, professor in the Imperial Japanese navy, who is on his way to Europe to attend the coming International Wireless Telegraphic Congress at Berlin. Dr. Kimura is one of the foremost experts on this subject, in Japan, and the wireless telegraphic system employed during the late war and in use to-day by the Japanese navy is of his invention. All the methods of wireless communication extant at the present time are based upon the same principle, and the various systems are differentiated principally in detail. Hence it will be understood that Dr. Kimura's invention, as he himself says, was principally of a constructive nature; but nevertheless, as such, it was considered by the Navy Department to possess so many distinct advantages that it was adopted in all its details. The German "Telefunken" Company, the exploiter of the foremost German system, has claimed that Dr. Kimura's invention is an infringement of its own patent rights, and the matter has been taken to court, though no decision has as yet been arrived at.

In 1900 the Navy Department of Japan appointed a research committee for the purpose of investigating wireless telegraphy and telephony, and of this committee Dr. Kimura was a member. In 1903 a new laboratory for test purposes was erected at Yokosuka, at the Naval Ordnance Depot. The Japanese government conducts a similar laboratory under the Department of Communications for like investigative purposes, but the two laboratories are quite distinct and, unfortunately perhaps, there is no correlation of the work carried out in them. Considerable research apparatus was imported from England, Germany, and the United States when the Japanese government first took up the subject of wireless communication. Dr. Kimura in beginning his work at the Naval Laboratory, was enabled to study receiving and transmitting apparatus quite separately, one from the other, and thus, for instance, was able to measure the strength of the waves regardless of the action of the receiver, or to investigate the effect of syntonization regardless of the method of transmission. Practical experiments to test his theories and apparatus were carried out by means of temporary balloon stations at distances of 80 to 100 miles, and when these tests were found to be highly successful, the system was adopted by the Navy Department. At the same time Dr. Kimura discovered, quite unexpectedly, that there was a decided telephonic effect in certain phases of the wireless telegraphic phenomena, and this led to his most important invention of a wireless telephone system which is said to be on entirely new lines, and which has been so far perfected that it is of practical utility. We understand that the Japanese navy has adopted this system, and will shortly install it upon various war vessels. We are, of course, in ignorance of the details of this invention, as it, together with Dr. Kimura's wireless system, are government secrets jealously guarded by the Navy Department. These important inventions were made while Dr. Kimura was acting in his capacity as an officer of the Japanese navy, and he received no special remuneration as reward for his work; the inventions are not even patented.

As instancing the success with which Dr. Kimura's wireless telegraph system has been used, an occurrence during the late war may be mentioned. At the time of the battle of the Sea of Japan, the weather was foggy and hazy to such an extent that it was impossible to see for a distance greater than five miles. A Japanese scout cruiser while searching for the Russian fleet suddenly found herself, when the fog had lifted unexpectedly for a moment, practically in the midst of the numerous vessels of the enemy. A wireless message was at once transmitted giving notice of the discovery, and this message was simultaneously received by all the vessels of the Japanese squadrons, notwithstanding that these were some 150 miles distant. Admiral Togo immediately dispatched a squadron of scouts, which kept in touch with the enemy and informed him at five-minute intervals of the course, speed, position, and location of the Russians with such accuracy that Admiral Togo was able to forecast with absolute precision the actions of the enemy. It was through wireless communication alone that it was possible for the Japanese commander to maneuver and place his fleet to enable him to strike the enemy in the most favorable position and under the most advantageous circumstances. It is incomprehensible that the Russians made no attempt to interfere with the Japanese wireless communication, for it was afterward found that nearly all of the Russian ships were equipped with the latest and most efficient wireless outfits.

During the course of the war it was discovered that at certain times it was possible to transmit intelligible messages through remarkably long distances, even as great as 1,000 miles, notwithstanding that the installations upon warships are usually designed for maximum distances of about 300 miles. These phenomena were investigated statistically with the accuracy and thoroughness which so often characterize the work of the Japanese. The researches were carried on principally by Lieut. Yamamoto of Admiral Kamimura's staff. He studied the conditions obtaining at the times of these extraordinary messages, meteorologic and magnetic, paying great attention to the condition of the atmosphere, the hour at which they occurred, etc. It was found that it was possible to transmit messages over such great distances only when the atmospheric pressure was very high at both the transmitting and receiving points, as well as through the intervening distance, and when the atmosphere was practically devoid of outside electrical disturbances. These phenomena occurred most frequently between September and April during the colder months, and between dusk and dawn, the maximum usually being between 11 P. M. and 2 A. M. The study of these phenomena in the Japanese navy was begun about September, 1904. In January, 1905, the DeForest Company announced in the Electrician that a message had been sent across a distance of 600 miles. No statistics concerning this message are available, but it is probably true that the conditions described above obtained at the time that this message was transmitted. Marconi made similar observations as far as sending messages at night is concerned, but without investigating with regard to the atmospheric pressure. It is believed that the United States navy has been conducting researches on similar lines, and has been aware of these interesting phenomena for some time past.

According to a report of the Yokohama Chamber of Commerce, a plan for dredging the harbor of Yokohama inside the breakwater has been framed. It was originally intended to divide the harbor into four separate sections, having 20 feet, 24 feet, 28 feet, and 32 feet of water, to facilitate the anchorage of vessels, but, in view of the advent of large vessels, the authorities found it necessary to provide berths drawing at least 35 feet of water. The plan has, accordingly, been modified, and the dredging work is to be completed in nine years' time.

THE HEAVENS IN OCTOBER.

BY HENRY NORRIS RUSSELL, PH.D.

Our map shows the heavens as they appear in the early evening to an observer lying on his back with his feet to the southward.

The Milky Way extends its great arch right across the heavens. Along its line are many brilliant constellations, for the most part familiar to us. Beginning in the southeast, we see Sagittarius, the Archer, just setting. Above it, past a region of great star-clouds, is the Eagle (Aquila) near which is the small group of the Dolphin. Almost overhead, but rather west of the zenith, is the fine cross of Cygnus, the Swan, west of which is Lyra.

Cepheus, which is not a bright constellation, comes next, just above the Pole, and then we reach Cassiopeia which is much more conspicuous. Below this is Perseus, whose most remarkable star, though not its brightest one, is the variable Algol, marked with the Greek letter β on the map.

Half-way between Cassiopeia and Perseus (though in the territory of the latter) is a bright condensation in the Milky Way, visible easily to the naked eye. This spot is one of the finest things in the sky to look at with a small telescope, for it is a great cluster of stars, some of which are bright enough to be seen separately with a field-glass, though not by the naked eye.

Still lower, on the northeastern horizon, Auriga, the Charioteer, has just risen.

The summer constellations are now disappearing from our view. Ophiuchus and Serpens are low in the west, and Hercules and the Northern Crown are but little higher up. Beneath them we still see a few stars of Boötes (the Herdsman) which are following their leader, Arcturus, which has already sunk below the horizon.

The Great Bear is at the lowest point of its circuit and lies flat on the northern horizon. Above it is the Dragon, whose head is still quite high, near Lyra. The two bright stars β and γ mark its eyes, and from them its body can be followed on long curves to a point below the Pole, between the Great and Little Bears.

The star α in this constellation deserves special notice. Though now remote from the Pole, it served the Egyptian astronomers as a pole star, for about 3,000 B. C. the celestial pole, in the course of its slow circuit about the pole of the ecliptic, passed very near this star, so that it was even closer than Polaris is now. This star is also noteworthy for another reason. The ancient and medieval astronomers always described it as of the second magnitude—that is, as bright as the Pole-star, or as the principal stars of the Dipper. It is now obviously much fainter, so that it would seem that it must have lost two-thirds of its former brightness within the last few centuries.

Turning now to the southeastern half of the sky we see, not far from the zenith, the great square of Pegasus. One of its corners belongs to Andromeda, but the other three are legitimate parts of the constellation from which it is named.

The western edge of this square, extended downward, points us to the planet Saturn, and going as far again to the bright star Fomalhaut, which belongs to the Southern Fish. Still lower down are some of the stars of the Crane, which can only be well seen from the southern part of this country. Capricornus, the Sea-Goat, and Aquarius, the Water-Bearer, lie above these constellations. The former is notable on account of the two double stars α and β, and the latter because Saturn is now within its borders.

The Fishes (Pisces) are not at all conspicuous, but the Ram (Aries) and the Bull (Taurus) are prominent constellations. The latter includes the Pleiades, which are now fairly well up, and the bright star Aldebaran, which is just rising.

In the southeastern sky the principal group is Cetus, the Whale. Its brightest star, β, is quite conspicuous, since it stands very much alone, some distance to the east of Fomalhaut.

The star marked o on the map is not visible at present. It is the famous variable Mira, which is usually to be seen only with a telescope, but which becomes visible to the naked eye for a month or so, at regular intervals of eleven months. Its next maximum is due toward the first of December.

THE PLANETS.

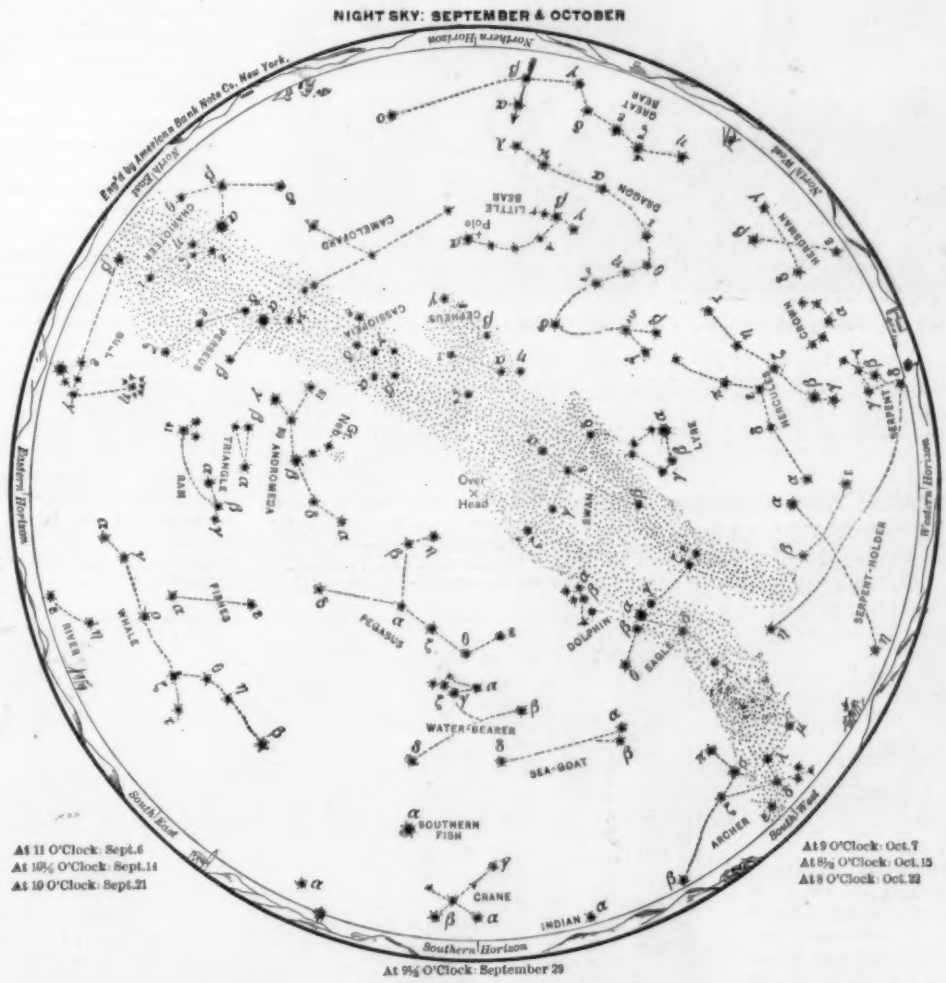
Mercury is evening star throughout the month, but it is only toward its end that he can be seen, and even then he sets less than an hour later than the Sun.

Venus is likewise evening star, and reaches her greatest brilliancy on the 25th, but she is very far south, and sets at about 7 P. M.

Mars is morning star in Leo, rising at 4 A. M. in the middle of the month.

Jupiter is in Gemini and rises about 10 P. M. Saturn is in Aquarius, and comes to the meridian about 9 P. M. on the 15th, so that he is well seen in the evening.

Uranus is in Sagittarius, setting at 9:30 P. M. on the 15th. Neptune is in Gemini and rises about 10 the same date.



In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed, counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

THE MOON.

Full moon occurs at 7:40 A. M. on the 2d, last quarter at 10:31 A. M. on the 10th, new moon at 5:34 P. M. on the 17th, first quarter at 8:42 A. M. on the 24th, and full moon again at 11:38 P. M. on the 31st.

The moon is nearest us on the 19th, and farthest off on the 7th. She is in conjunction with Jupiter on the 9th, Neptune on the 10th, Mars on the 15th, Mercury on the 18th, Venus on the 20th, Uranus on the 22d, and Saturn on the 27th, at 5 A. M. This last conjunction is pretty close, and an occultation of the planet is visible in Australia.

The United States Navy Department, in its recent power extensions to the New York navy yard, has, through its bureau of yards and docks, adopted Westinghouse-Parsons steam turbines, which will be installed in building 41. The present installation will comprise two 500-kilowatt units, operating under 150 pounds steam pressure, 28 inches vacuum, and on superheated steam at 100 deg. F. The power plant supplies three-phase alternating current at 2,300 volts, and 60-cycle frequency, to machine shops, drydocks, and other general purposes about the New York yards, including lighting of buildings.

Nitrification of Sewage by Shallow Filters of Fine Particles.

Dr. George Reid presented before the Physiological Section of the British Association, a paper on "Nitrification of Sewage by Shallow Filters of Fine Particles." The author stated that he had always advocated fine-grain sewage filters, used as percolating filters, not as contact-beds; but he had not until recent experiments known that the reduction in the size of the particles allowed of the construction of much shallower, and therefore less costly filters. The Local Government Board did not pay any regard to the size of particles, nor to the depth of the filter, so long as the minimum depth of 4 feet was provided, the sole governing principle being cubic capacity in relation to sewage flow, irrespective even of the strength of the sewage. If nitrification were dependent upon the activity of aerobic organisms, it would seem that we should give as large a surface for bacterial growth as possible by reducing the filter particles to the smallest size compatible with free aeration and practical working conditions. He had obtained the best results with filter particles of ⅛ inch, while the usual practice was in favor of particles of from 1 inch to 3 inches or 4 inches. Recently he had had an opportunity of experimenting with some filters which had for four years invariably given high-class effluents. The plant comprised a straining chamber, three detritus tanks, a septic tank—which, together with the detritus tank, gave a period of quiescence of 27 hours—and a ¼-acre percolating filter, 4 feet 6 inches deep, formed of ¼-inch hard non-friable particles. The septic tank effluent was applied to the filter at the rate of 200 gallons per superficial yard by means of a power-driven apparatus, distributing the sewage at intervals of five minutes. In the filters he had embedded four trays, at 1-foot intervals, in such a way that there were no two trays in the same vertical line, in order to separate the effluents from different depths of the filter. He had found that the suspended solids were practically retained by the surface layers where the organic portions were liquefied. Within the first foot the organic matter was almost completely oxidized, the free ammonia being reduced from 1.71 to 0.03 part in 100,000; the albuminoid ammonia from 0.34 to 0.05; and the oxygen absorbed from 2.18 to 0.32; the oxidation of the carbonaceous matter was practically complete. Thus a very high-class effluent resulted from filtration through 1 foot of filter, and very little work was left for the lower strata of the filter. The loss on calcination of the filter particles was at the depths of 6 inches, 1 foot, 2 feet, 3 feet, and 4 feet: 3.25, 0.99, 0.65, 0.53, and 0.53 per cent. There was, however, an increase of free ammonia in the lowest tray. But the general conclusion seemed to be justified that, given fine particles and good distribution, filters might be constructed much shallower than hitherto, and that it was better to increase the area than to deepen the filter.

The technical college in which the future engineer is to be trained has several important characteristics to maintain. First, to educate scientifically and technically those who shall lead the march of the coming civilization in industrial lines; second, to educate the public to a true sense of the value of applying scientific principles to industrial processes; third, as the university has for one of its functions the extension of human knowledge in any and all lines, so the technical colleges will recognize that the investigation of questions relating to applied science is within their own sphere of usefulness. While the university asks no questions about the usefulness of the information gathered within its walls, the technical college must make its investigations in fields that are distinctly useful.

THE ERECTION OF THE QUEBEC BRIDGE.

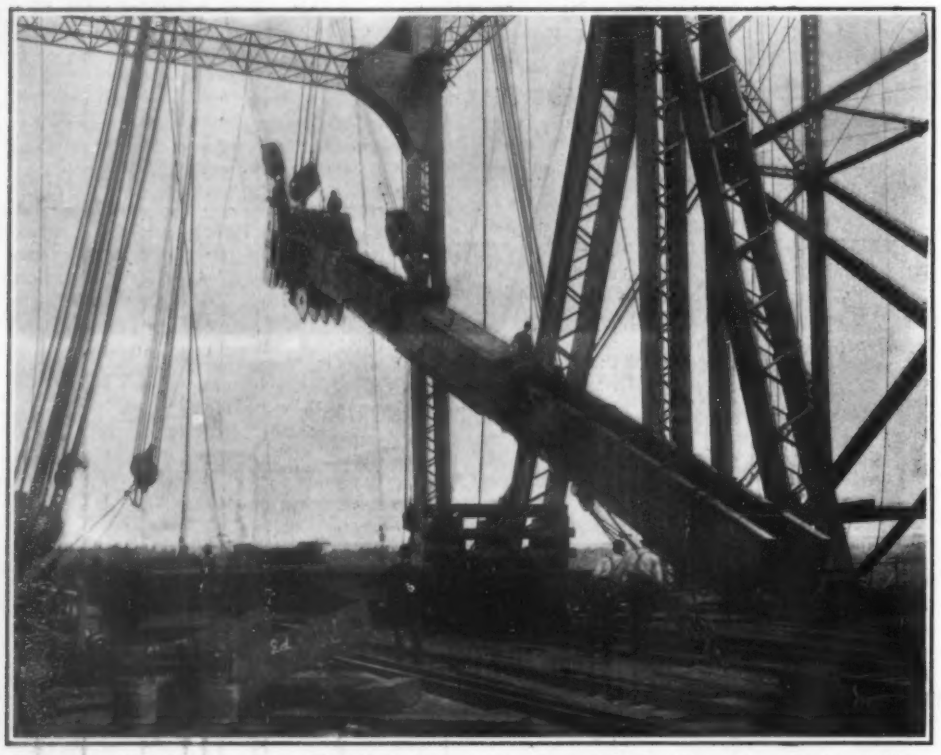
We present illustrations showing the progress of the highway and railroad bridge across the St. Lawrence River at Quebec which, when completed, will be in some respects the most monumental structure of the kind yet erected. The bridge will have a total length from center to center of anchorage piers of 2,800 feet. It will consist of two 500-foot anchor spans, extending from the anchor piers to the main piers of the towers; two 562½-foot cantilever arms, reaching out over the river, and carrying between them a central suspended span, measuring 675 feet between centers of end pins. This span is one of the striking features of the bridge, and illustrates well its huge proportions; for it is longer than any simple pin-connected truss span that has yet been erected. Ordinarily such a span would be supported on masonry towers, and it would form, say, the main channel span of some river crossing; but in this case its abutments are the end pins of two giant arms each reaching out over half a thousand feet from its point of support. The cantilever arms and the central span together form a channel span 1,800 feet in length, or 90 feet longer than the cantilever spans of the Forth Bridge.

The under side of the channel span is 150 feet above high water of the St. Lawrence River, and the depth of the cantilever trusses over the main piers is 350 feet. The total height from low water level to the highest point of the cantilevers is 414 feet. This bridge is by far the most massive trussed structure yet erected for any purpose, and the great size and weight of the individual members is due, not only to the great length of the span, but to the width of the roadway and the exceedingly heavy live and wind loads which it must carry.

The two trusses stand in vertical parallel planes, placed 67 feet apart, center to center. Between these trusses is supported a floor system capable of accommodating two steam railroad tracks, two electric car tracks, and two highways for vehicles, all of which are placed between the two trusses, while outside of the trusses are two sidewalks. In making calculations for the train loads provision was very wisely made for an increase in the future of 50 per cent over present weights. These accumulated live loads, together with the wind loads estimated at 25 pounds on every square foot of surface of the structure, have to be added to the dead load of the structure itself, which amounts to a total of 40,000 tons. The calculations of sizes of members have been so made that when the bridge is completed, loaded to its maximum capacity, and exposed to the fiercest gale that will blow upon it, the maximum stress in the tension members will never exceed 17,000 pounds to the square inch in the I beams, or 20,000 pounds per square inch in the secondary members.

One of the most important problems to be solved, both in designing and erecting the bridge, was to keep the weight and size of the individual members down to a point at which they could be transported from the shops of the Phoenix Bridge Company to the site of the bridge, and lifted into position and connected up by the erecting gangs. In many cases the members were so large that they about reached the limit of capacity of the tools by which they were made in the shops.

Our illustrations show the work of erecting the south anchor arm, which has recently been completed. The trusses are 96 feet 9⅜ inches deep over the anchor pier and 315 feet deep over the main pier, and they

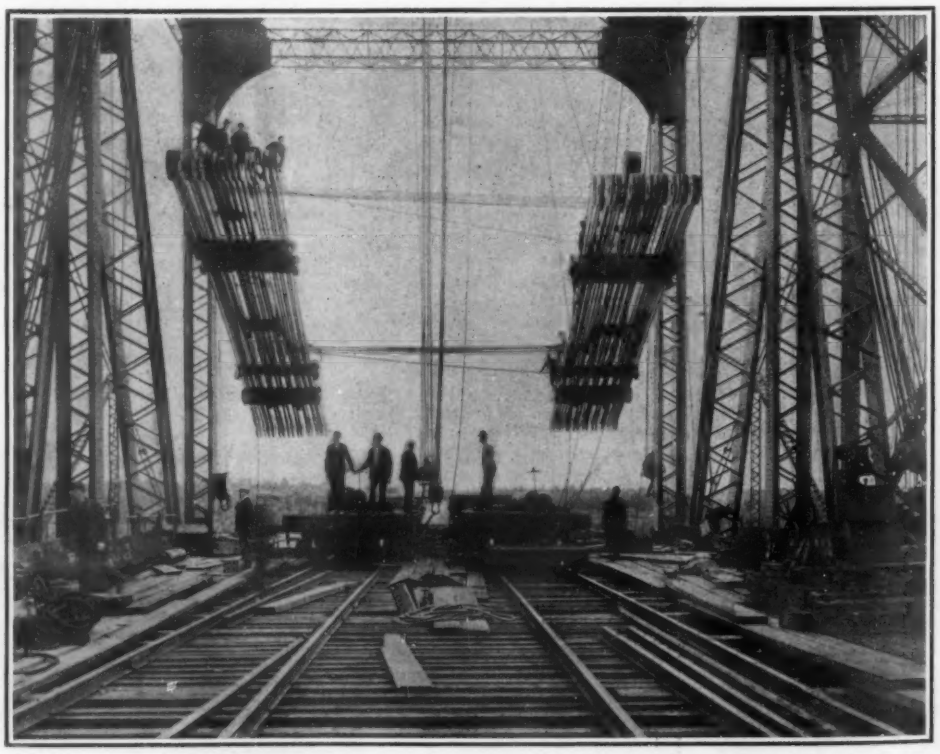


Raising the Top Section of the First Main Intermediate Post of the Cantilever Arm, Quebec Bridge.

are divided into five main panels of 100 feet span, or ten sub-panels of 50 feet span. The diagonal compression members have riveted connections at the intersections, but the vertical posts and the top and bottom chords have pin connections, the pins ranging in diameter from 12 inches to 24 inches. The two main vertical posts over the piers are heavily braced transversely, and form, in fact, a vast transverse truss 67 feet wide, 315 feet high, and weighing 1,500 tons. For convenience of transportation the vertical posts were made in two or more sections, which were riveted together as they were erected. The bottom chord is 4½ feet deep by 5½ feet wide and is built up of four webs, having a maximum cross section of 842 square inches. The eye-bars are 2½ inches thick by 15 inches deep. They have a maximum length of 76 feet. Some of the 12-inch pins used at their connection are over 10 feet long. The main shoes at the bottom of the tower posts weigh 46 tons. The floor beams at each panel point are 10½ feet deep and weigh 30 tons apiece. Each top chord is made up of twenty eye-bars, and the maximum stress of dead, live, wind load, and impact reaches the enormous figure of over 8,000 tons. The total cross sectional area of the top chord to take the stress is 711 square inches.

For erecting the anchor span, whose great load had to be entirely carried by the false work, it was necessary to put up eighteen steel falsework towers ranging from 127 to 160 feet in height, which were braced together to form transverse supporting bents, one under each panel point. The bridge members, as they reached the site of the bridge, were stored in a special yard, whence they were reloaded on delivery cars and run out over the falsework to the desired point on the bridge. Here they were erected by a 54 foot wide by 103 foot long steel traveler, which is 212 feet in height. This traveler is provided with 54-foot and 66-foot cantilever extensions forward at the top and to the rear at the bottom, which give to it the Z-shape contour which will be noticed in our illustration. The traveler runs on tracks at the level of the roadway, and between the trusses, which, of course, it clears. It is provided with 33 tackles of from 12 to 55 tons capacity, which are operated by four electric hoisting engines of special design. The whole traveler with its engines complete weighs about 1,125 tons. The largest pieces handled thus far have been the center sections of the main vertical posts which weigh each about 95 tons. These posts have a cross section of 5 feet by 10 feet with four transverse webs.

In hoisting the heavy members into position, they were slung in the tackles, approximately at the angle at which they were to be built into the bridge, and hoisted into position and the pins inserted in no more, and in some cases less, time than would be necessary in a bridge of smaller proportions, the celerity of erection being due to the fact that practically the whole of the work was done by electrical power. One of our front-page illustrations shows the method of hoisting the top chord eye-bars. As a single top chord panel is made up of as many as twenty-eight 15 x 2 1-16-inch eye-bars, weighing altogether 140 tons, it was decided to assemble such a set of bars for one panel complete in the storage yard, space them to position by wooden fillers, and clamp them together with yokes and heavy bolts. The set of bars was then hoisted, as shown in our illustration, and when it reached the top of the bridge, some 850 feet above the water, the eyes were sure to be in perfect alinement, and the work of matching them with the other connections and pinning the whole together greatly facilitated. Our thanks are due to the Phoenix Bridge Company for information and photographs furnished in the preparation of the present article.



Raising Two Complete Panels of Upper Chord Eyebars, Weighing 140 Tons, to Position in Quebec Cantilever Bridge.

ERECTING THE QUEBEC BRIDGE—THE LONGEST-SPAN BRIDGE EVER BUILT.

Stephenson's old "Invicta" locomotive, which seventy years ago used to run between Canterbury and Whitstable, was formally unveiled at Canterbury recently by Sir David Salomons, who presented this interesting railway relic to the town council.

AN IMPROVED OZONE GENERATOR.

BY CHARLES H. COAR.

In 1875 Van Marum, a noted chemist, discovered that the passage of electric sparks through the air produced a peculiar odor, but neither Van Marum nor his fellow collaborators were able to define the gas which emitted this odor, nor could they analytically reduce it to its constituent elements. In 1840, however, Schonbein, an eminent scholar who occupied the chair of chemistry at the University of Basel, Switzerland, in prosecuting his inquiry into the nature of the gas generated by the application of electric sparks to the air, discovered that the oxygen of the air when exposed to the action of electricity of the proper potential underwent a great change; the volume was contracted and it acquired properties that were remarkably different. For instance, its weight was increased and its chemical activity greatly enhanced. This change, it has been proven, consists of a conversion of the oxygen into an allotropic modification which has received the name "ozone" (from the Greek *ozo*—I smell), an allusion to its peculiar odor. Ozone is an allotropic form of oxygen which is absolutely decomposed at 270 degrees, and partially decomposed by any lesser degree of heat, so that it at once follows that it is impossible to convert oxygen into pure ozone by the direct application of electric sparks, for while they form ozone they also decompose it. This may make the ozone dangerous, as there is no certainty as to how far it may go. Supposing the ozonization to have reached a certain proportion, each additional spark, besides producing ozone, will decompose pa..t of that originally produced, as the sparks oxidize nitrogen of atmospheric air more rapidly than does the silent discharge, and the product of this is largely composed of oxides and other poisonous gases.

Ozone, even at ordinary temperatures, will gradually relapse into its original state of plain oxygen, and ozone once decomposed by heat or otherwise becomes oxygen and must be subjected to the action of the electric current again, so that obviously the lower the temperature of oxygen or air electrically treated, the greater the chance of the ozone to remain active. The ozone of nature is generated without heat and is delivered without oxides or obnoxious gases as is the case when it is chemically prepared or generated by the means heretofore known to science by electrolysis of water solutions, etc. The ozone of nature is a colorless gas that is always especially plentiful in high altitudes, and is ever present in the atmosphere to a more or less degree owing to conditions and circumstances. In converting oxygen into ozone, the action of the electric current is to compress the oxygen into a less number of molecules, being three molecules into two.

In the course of experimentation to which, for nearly three quarters of a century, ozone has been subjected, it has been fully demonstrated that pure, or relatively pure, ozone exerts a powerful therapeutic influence upon the respiratory organs, through its action upon them, destroying all germ life in these organs. It is penetrating and leaves a chemically metallic taste in the mouth of one using it which is not easily dissipated or forgotten. Pure ozone properly applied tends to purify and also increase by this means the blood stream, and all the weakened tissues. It is especially valuable in the treatment of diseased respiratory organs and should prove one of the most important factors in the treatment of tuberculosis. The ozone of nature has always been found of great value medicinally, it not being uncommon for physicians to send patients for treatment to such parts or portions of the country as are well supplied with the ozone of nature. The ozone of nature has insufficient strength to be of any value commercially, and consequently scientists have endeavored to devise some means to generate it mechanically and still keep it pure as the product of nature. Heretofore the manufactured ozone has had too many foreign gases mingled with it to be of any value therapeutically or commercially.

The ozone generator illustrated in this article is a recently invented apparatus for generating pure ozone, in which the oxygen is electrically ozonized without contact with heat or flame, which in consequence means no increased temperature. These are not desirable in the production of pure ozone, as any contact with them tends to produce nitrous fumes and oxides from nitrogen only, which, when inhaled and subjected to the moisture of the breath, produce nitric acid from the fumes and chemical changes in the oxides, either of which is undesirable. The generator, as will be described, is extremely simple and generates an unusually large percentage of relatively pure ozone from a given quantity of oxygen of the air or pure oxygen if desirable. The generation of ozone in this apparatus is effected directly from the air by means of an interposition of dielectrics between the terminals of the converting device or generator proper, which have points in contact with the dielectric throughout their entire surface, thus doing away with the unfortunate air gap of former methods, over which the current must leap of necessity, thus creating heat or sparks which act, as heretofore stated, directly upon the nitrogen of the air, decomposing it into injurious gases as well as creating oxides. In this instance the method of placing the dielectrics in the converter has obviated the necessity of employing extremely high voltages such as were heretofore used.

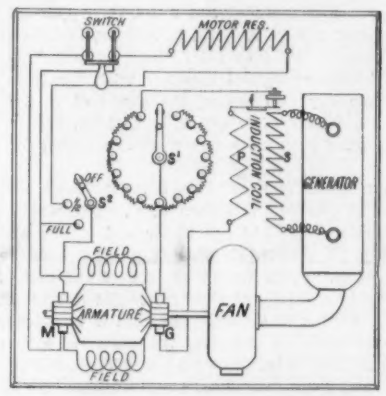


Fig. 3.—The Circuits of the Ozone Generator.

The complete generating outfit as shown in Fig. 1 is very compact, being mounted on a base 17 inches square. Fig. 2 illustrates the method of applying the set during medical treatments. Fig. 3 shows the assembly and circuit arrangement of a set designed to be used where direct current is available for propelling the motor. The sets are also designed for use where alternating current is available, but in this case the motor equipment is dispensed with, a small step-down transformer being used to transform the current down to approximately five volts, at which pressure it is delivered to the induction coil. The direct-current set is supplied with a small 1/40-horse-power motor generator set, running at about 1,800 revolutions per minute. The generator end, *G*, of the motor set has about 10 watts capacity and delivers current at five volts pressure through a regulating rheostat, *S'*, to the primary winding, *P*, of a ¾-inch spark coil. The motor end of the set is connected to the outside source of current by means of an ordinary lamp plug and socket, the current consumption being approximately the same as is required for a 16-candle-power lamp, and thence through the double pole switch and motor rheostat to the armature and field windings. The motor also propels a 4½-inch fan which creates a suction of air through the converter and causes the generated ozone to be delivered by means of a flexible tube connected thereto to the point of usage. During operation the generator delivers current to the primary winding of the induction coil, which is equipped with a make-and-break contact causing a potential of approximately 6,000 volts to be generated in the secondary winding, which is connected to the converter as shown. The converter shown in Fig. 4 is composed of a plated tube 2½ inches in diameter by 9 inches long, one end of which is open for the admittance of air while the other end is connected to the suction fan and flexible tubing as mentioned. Inside this tube are placed five conducting plates alternately connected to common terminals but insulated from each other by dielectrics composed of French glass plates, *G'*. The conducting plates are 5 inches long and 1¼ inches wide and are composed of two narrow fiber strips, *F*, each being provided with a narrow slot for the admittance of crimped narrow aluminium ribbons which are fastened therein between the two fiber strips in such manner that a screen is formed which will have many points in contact with the plate glass dielectrics. The small aluminium ribbons are bonded together by an aluminium wire extending through in contact with each individual ribbon in the one strip or conducting plate in such manner that they become as one conductor. This aluminium wire is brought out and connected to its proper terminal as shown. Such a plate is placed between two glass dielectrics, so that it forms what may be termed a ventilated condenser, each glass dielectric having contact with different aluminium conducting plates on opposite sides. Three of these aluminium plates are connected to a common terminal which in turn is connected to an insulated binding post mounted upon the containing tube. The two remaining aluminium plates are connected in common with two small tin-foil strips, *T*, which are placed in contact with the outside surfaces of the two outer glass dielectrics, and the common terminal thus formed is connected to the remaining insulated binding post. This arrangement is shown in Fig. 4. The different plates and dielectrics are bound together in a square form by mica, *M*, and the whole snugly fits into two fiber washers, *W*, which fit inside the containing tube. In this mounting the form is slipped into the tube and the electrical connections made, after which melted paraffin, *P'*, is poured about the ends and allowed to set, thus preventing the passage of air through the tube excepting through the openings provided in the aluminium plates as shown in the end view.

During operation the voltage delivered from the secondary winding of the induction coil to the aluminium plates causes a Brush discharge to occur between the various plates and dielectrics, thus converting the oxygen sucked in by the fan into ozone. There is in this arrangement a perfect effluvium of electricity between the aluminium plates and dielectrics, because of their nearness to each other and the many contacts present, which is comparatively

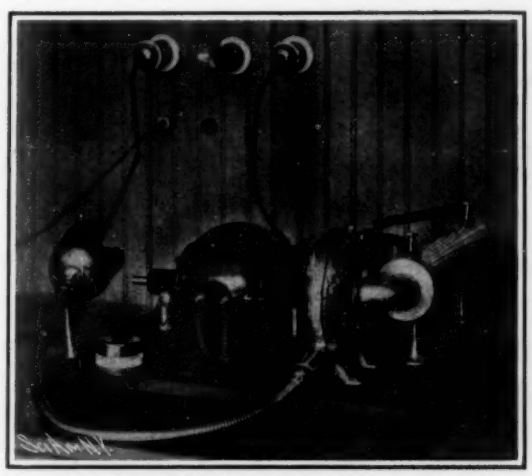


Fig. 1.—General View of the Apparatus.

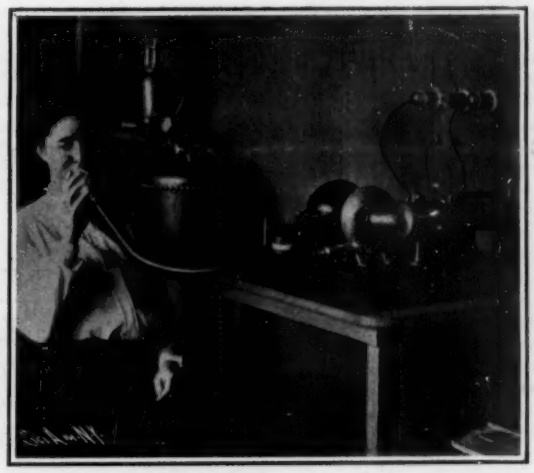


Fig. 2.—The Apparatus in Use.

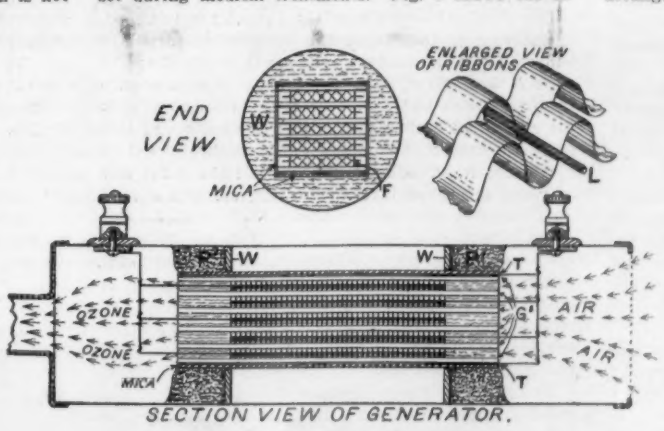


Fig. 4.—Details of the Ozone Generator.

AN IMPROVED OZONE GENERATOR.

silent and cold, a condition necessary and ideal for the generating of the purest ozone. A generator similarly constructed but of much larger proportions, is being extensively employed of late in flour mills, the arrangement being to subject the grain to drafts of ozone, which tends to destroy fungous growth, insect eggs or any form of bacteria as well as accomplishing other desired results in the finished and by-products.

New Applications of Compressed Air.

Apart from its extensive employment in tunneling and foundation work, compressed air is being applied in rapidly increasing measure to various branches of engineering work with much advantage, says the Engineering Review. Pneumatic tools such as hammers, riveters, calkers, drills, and the like are fairly universal, but in addition to these, various new appliances of quite different character are now finding extensive use. The adaptation of compressed air for raising water is a natural and logical application. Various devices have been employed and are constantly being developed for this purpose. Some of these, such for instance as the air lift and forms of the direct displacement pump, fully hold their own by reason of convenience or compliance with conditions prohibiting other apparatus. But all appliances of the kind suffer from the drawback that they are not economical in operation. The chief objection to the direct displacement compressed air pump is that it does not utilize the potential energy of expansion and allows the air to escape at full pressure. This disadvantage is obviated by the return-air pumping system which embodies a most important invention. While the familiar direct displacement pump receives for each charge all the compressed air it will hold and rejects all of it, the return-air pump, working in a similar way, only uses the power actually necessary, and returns the balance to the intake side of the compressor. The return impulse of the air during expansion converts the displacement pump into an economical machine, and opens up great possibilities of additional uses for compressed air in permanent pumping plants in connection with water supply installations, and, in fact, for raising any liquids that can be dealt with by other pumps. Another new invention related to the return-air pump, although employed in quite a different direction, is the electro-pneumatic rock drill. This machine is of revolutionary character in design. The drill has no valve or valve motion. A small air compressor is fitted near the drill to be operated; two pieces of hose each connect one end of the compressor with one end of the drill cylinder, and there are no valves or obstructions to prevent the free flow of the air through the hose or into or out from either cylinder. The compressor is driven by a small electric motor mounted upon the same frame. As the compressor piston moves to and fro, the pressure rises in front of it and falls behind it, causing alternations of pressure at the two ends of the drill cylinder, and thereby operating the drill piston. After the first charge no additional air is taken in, except to compensate for leakage, and none is discharged. The drill piston is checked at each end by the elasticity of the air so that the force is not lost, but is transmitted to help the next stroke. Thus the important economy of the return-air pump is reproduced in another way. The new form of drill has been worked under exacting conditions for several years in this country.

Volcanic Dust Fog.

M. Stanislas Meunier, the well-known authority upon meteorological effects, gives an account of a phenomenon which occurred at Paris and which was no doubt caused by the eruption of Vesuvius. On the morning of the 11th of April a dry and yellowish fog extended over the city. It was strong enough to interfere with the navigation on the Seine, and the sun appeared under a peculiar aspect. Supposing that this phenomenon might be caused by the eruption of Vesuvius, M. Meunier placed upon the roof of his dwelling a series of plates covered with glycerine so as to retain the floating dust. These plates when treated with water gave a rather abundant deposit in which soot and organic matter were visible to the naked eye. The fine portion of the deposit, which was separated by the Thoulet heavy liquid, gave an extremely fine sand, and a microscopic examination of this confirmed M. Meunier's idea.

Comparison of this sand with the ash sent up by Vesuvius in 1822, of which he had a sample, showed a complete identity with the latter. The main difference consists in the presence of some perfectly spherical globules of oxidized iron in the Paris dust. We may, therefore, admit that the fog seen in Paris was caused by the very fine dust sent up from Vesuvius.

A HOME-MADE EQUATORIAL MOUNTING FOR TELESCOPES.

BY CARL L. GRUPPEN.

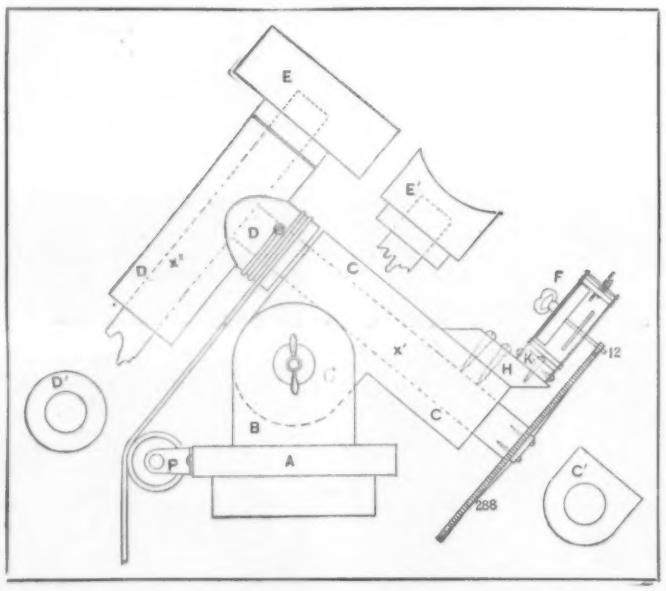
The accompanying illustration shows an equatorial stand for a small telescope, which may be made entirely of wood. An equatorial stand is not a novelty by any means, but one made from wood is certainly a rarity.

The illustration shows only the head of the stand, the tripod being fastened to the piece *A*. Maple is as good a wood as any on account of its close grain. The piece *A* is made of two disks, the upper 5 inches in diameter and ⅝ inch thick, and the lower 4 inches in diameter and 1 inch thick.

The pieces are glued together with furniture glue and when dry two pieces, the shape of *B*, 3 inches wide, 3½ inches high and 1 inch thick, are screwed tightly onto it, with a space of two inches between them.

The member marked *C* is 2 inches thick and the section of one end is shown at *C*. The whole piece is 6 inches long. At the upper end it has an arm, marked with a dotted *C*, which fits in between the two pieces of *B*. From its upper face to the end of the arm is 4½ inches, and the arm is the same width as the pieces of *B*, 3 inches. The arm is rounded off to the same circle as *B* and at the center of each curve a ¼-inch hole is bored to take a bolt passing through the arm and the two pieces *B*. By means of a thumbscrew it is possible to clamp the piece *C* in any position. A 1-inch hole is bored all the way through *C*, and this forms the bearing for the polar axis.

The piece *D* is formed of two intersecting cylinders each 2 inches in diameter. The longer piece is about 5½ inches and the shorter extends only 1 inch to one side of the longer and is joined onto it 1 inch from the upper end. After the pieces *D* are glued firmly together, a 1-inch hole is bored through the center of the smaller piece till it intersects the longer boring.



A HOME-MADE EQUATORIAL MOUNTING FOR TELESCOPES.

The axes of the stand are made of 1-inch dowels and a piece 8½ inches long serves for the polar axis. One end of this piece is glued tightly into *D* but not far enough to interfere with the passing of a similar dowel through the longer cylinder.

The free end of the dowel marked x^1 is rubbed with graphite such as that used on bicycle chains, to make it turn easily, and is pushed into the hole in the piece *P*.

The member *E* serves as the bed of the telescope. A shoulder ½ inch thick and of the same diameter and section as the longer cylinder *D*, is glued to the piece *E* which is made of any convenient size, according to the size and curvature of the telescope. *E* is the section of such a piece. Into the bottom of this is bored another 1-inch hole and another dowel is glued into it. The dowel may be left about 2½ feet long. It is pushed through the long cylinder x^2, and thus forms the declination axis.

The telescope is attached to *E* by means of strips of brass passing over its barrel and is fastened with screws on each side of *E*. When the telescope is mounted, a sliding weight, about half as heavy as the telescope, is adjusted on the free end of x^2 which was left 2½ feet, and when the telescope is balanced by it, the dowel projecting beyond the weight is cut off.

By means of the bolt passed through *B* and *C* the polar axis can be adjusted to the pole of the celestial sphere, no matter in what latitude the stand is used.

The stand thus made answers nearly all the purposes of the instrument purchased at a much greater cost, and if the builder wishes to attach a clockwork to make the telescope follow the object that is being viewed, it is as easy as the building of the stand. Get the movement of an ordinary alarm clock and procure a small gear wheel with 12 teeth, and mount it on the end of the shaft in the clock which carries the minute hand. Next get a larger wheel of the same pitch having 288 teeth, which can be procured at any hardware store. Drill holes through the hub of this and fasten it by means of four or five wood screws to the end of x^1, which projects through *C*. Mount the clock by means of the block *H* on *C* so that the wheel 12 engages the larger one 288.

Next procure some woven shade cord, and making one end fast by means of a screw and washer, pass it a few times around the smaller cylinder in such a direction that in unwinding it will turn the polar axis in the direction necessary to follow the stars from east to west. Pass the cord over the pulley *P* and hang a weight on the other end.

The shaft of the minute hand of the clock turns twenty-four times in one day, and as the larger wheel has twenty-four times as many teeth as the smaller, it will only turn once in a day.

The clock is not powerful enough to turn the telescope, but it will regulate the speed of the telescope which the weight is trying to turn by means of the cord unwinding from *D*. The shaft of the clock can be turned without turning the movement in order to set the clock, so that the telescope can be turned on the polar axis without disengaging the clock from it.

The weight on the end of the cord must be as heavy as possible, without being heavy enough to make the shaft of the clock slip in the movement. The alarm apparatus may be removed from the clock, as it is unnecessary. The description of the stand makes its construction appear really much more difficult than it really is, but it is worth the trouble taken by anyone scientifically inclined and with enough mechanical ability. The writer has made one, and this illustration is taken from his instrument. It works as perfectly as necessary for mere viewing purposes, but for photographic work the bearing of the polar axis should be lined with a brass tube and the axis itself made from iron or brass rod.

Hay Fever.

It is now known that hay fever is due to the invasion of the mucous membrane of the nose by the pollen of certain plants. This membrane is not equally sensitive in all persons; there are many who are quite immune from hay fever. Different pollens have not the same activity either; that of certain plants is innocuous, whereas that of other species is very active. The irritating action is really exerted by the pollen itself, and not by a bacterium of any kind. This has been well established by Dunbar. At present a hundred and fourteen plants are known to have toxic pollen; wheat, rye, and quite a number of gramina form a part of them. The active principle of the pollen consists of a granular amylaceous material, and lasts a long while. It is possible by snuffing up dry toxic pollen, to produce hay fever during the middle of winter. The toxin of this granular material has been separated, and it has been used in manufacturing an antitoxin. But the toxins of the different pollens vary; their antitoxins correspondingly. We can scarcely hope to find an antitoxin that will permit of treating hay fevers due to different pollens. It will be sufficient indeed to prepare antitoxins corresponding to the principal toxic pollens. The antitoxin should be administered by preference in a powder—a mixture of sugar and antitoxic serum. It generally cures and confers a certain immunity. Out of 222 cases treated, these results were obtained:

127	successes	say 57 per cent.
71	improvements	say 32 per cent.
24	failures	say 11 per cent.

The proportion is very encouraging.—From L'Illustration.

An intermittent filter will shortly be completed for the temporary treatment of the Ludlow reservoir supply of the Springfield, Mass., waterworks. Its object is to remove tastes and odors from the water during the summer season, and it is not for winter use or for removing a large proportion of bacteria. It was designed by Mr. Allen Hazen, and is being constructed by leveling off an area of about four acres on a point projecting into the reservoir, and covering it with coarse sand. Water will be pumped from the reservoir through a 24-inch pipe to an aerating fountain and thence distributed over the filters. The effluent will be collected in 8-inch drains 12½ feet apart, leading to a collector which terminates in a chamber where aeration will take place.

Correspondence.

The Pure Food Question Again.

To the Editor of the SCIENTIFIC AMERICAN:

I note in your esteemed issue of September 1 that you published an article from the prolific pen of the Chief of the Bureau of Chemistry, Department of Agriculture, criticising my communication published in your valuable issue of August 18.

Irrespective of the chief chemist's remarks, the law will compel the true labeling of all food products. Any manufacturer or packer of food stuff certainly labels his products. The label must be correct or the article will be deemed adulterated.

The law says in the case of food that it will be deemed adulterated:

First: "If it be an imitation of or offered for sale under the distinctive name of another article."

Second: "If it be labeled or branded so as to deceive or mislead the purchasers or purport to be a foreign product when not so or if the contents of the package as originally put up shall have been removed in whole or in part and other contents shall have been placed in such packages, or if it fail to bear a statement on the label of the quantity or proportion of any morphine, opium, cocaine, heroin, alpha or beta eucaine, chloroform, cannabis indica, chloral hydrate, or acetanilide, or any derivative or preparation of any such substances contained therein."

Third: "If in package form, and the contents are stated in terms of weight or measure, they are not plainly and correctly stated on the outside of the package."

Fourth: "If the package containing it or its label shall bear any statement, design, or device regarding the ingredients or the substances contained therein, which statement, design, or device shall be false or misleading in any particular."

I will not weary your readers with any more quotations from the law, as I am confident they will at once recognize the fact that the law does compel the true labeling of all articles of food. I will also say for the further authentic information of your numerous readers, that while the federal law does not mention borax or boric acid, it will allow the outward application of a non-penetrating preservative.

Boron compounds are of a non-penetrating nature and they are the preservatives recognized as the only ones that are allowed. The chief chemist is well aware of the fact. He says my communication was written "to induce the people to think that borax and boric acid are permitted preservatives, but this is not the case, as is shown by the recent regulation for the enforcement of the meat inspection act, in which all preservatives, with the exception of sugar, salt, spices, vinegar, wood smoke and, pending further investigations, saltpeter, are prohibited." The forgetful chief neglected to add to the above "unless specifically provided for by a federal statute."

The chief chemist then says, referring to boron preservatives: "If used at all, can only be used at the time of packing, only externally, and only when necessarily removed, and only when directions for such removal accompany each package." Another instance where the law will compel a label.

The chief chemist quotes some comparatively unknown Baltimore doctors who have freely quoted the chief, who without doubt supplied them with the matter which the chief quotes as follows:

"Borax and boric acid as preservatives are the subject of numerous conflicting opinions. It is possible that some of the favorable opinions have been issued by those who draw their salaries and their opinions from the same source. While it is stated by many that the use of these chemicals is not injurious, there are instances on record when they have caused severe symptoms and even death."

The completion of the article the chief overlooked, which is as follows: "Boracic acid and borax may, however, find their proper use in preserving meats such as hams for exporting purposes. Meat sprinkled with boric acid does not become slimy as it does without it."

The Baltimore doctors do not cite the cases where death occurred from borax. I am inclined to think they are unable to prove their statements, as I have made an exhaustive study of boron food preservatives and I do not know of an authentic case where a person has been injured, much less killed, by partaking of foods preserved with borax or boric acid.

Why did not the chief quote such world-renowned professors as F. W. Tunnicliffe and Dr. Otto Rosenheim, of London, who experimented with boron compounds on children? Their observations were made on three children, two boys aged two and one-half years and five years, and a girl aged four years, who was delicate, being convalescent from pneumonia. The result of their experiments on the children was that neither boric acid nor borax in any way affected the general health and well-being of the children.

The experiments made by the chief chemist also resulted in favor of boron preservatives. It is a well-known fact that the government employes who tendered their stomachs for Uncle Sam to determine the effects of borax and boric acid on the human system were, when the test was completed, in better physical condition than when they entered the contest seven months before; consequently, the fact is, that boron preservatives were not injurious to the boys or the invalid girl or to the members of the so-called "poison squad" or to the English nation who have consumed boraxed foods for decades. Consequently, these mild, innocent preservatives should not be condemned.

The above are facts that cannot be disputed, and as I well know the SCIENTIFIC AMERICAN desires scientific facts, I take pleasure in forwarding this communication to you. H. H. LANGDON.

New York, September 11, 1906.

The Causes of Gun Erosion.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest your editorial on "Gun Erosion" in the September 15 issue of your valuable paper. While I admit the correctness of a large part of your article, I do not believe that you have stated the entire case in regard to erosion. My reasons are as follows:

If the erosion of the bore of a rifle were due solely, or even principally, to the rush of gases past an imperfectly-fitting projectile, the destruction would be practically uniform along the entire length of the bore. If, however, the erosion is due to the action of the highly-heated and chemically-active gas confined behind the projectile, the erosion will become progressively less as the muzzle of the gun is approached, the reason being, of course, that the breech end of the bore is subject to the action of these gases for a comparatively longer period. As a matter of fact, the latter is the case, so we may conclude with certainty that a larger part of the erosion is due to this cause.

That these gases should produce serious erosion is entirely reasonable. Being under extremely high pressure, they are probably more active chemically than they would be otherwise, and have a solvent action upon any oxidizable metal, just as steam at high temperatures dissolves certain qualities of glass which are unattacked at ordinary pressures. On account of the very great temperature of explosion, several thousand degrees, the inner surface of the gun must be raised almost to a melting heat. The gases within the gun during an explosion are not by any means quiescent, but are probably circulating in currents of enormous velocity, due to the contraction of the bore immediately forward of the powder chamber. These powerful currents of intensely-heated and corrosive gases, playing upon the heated and softened steel of the gun, can have no other effect but to produce serious erosion.

On the other hand, the effect of the rush of gas by the projectile cannot produce as serious results. Since the gases can only pass the projectile in very thin streams, they must be comparatively cool. Not only so, but they encounter only the cool surface of the gun tube, since the heat has not had a chance to act on that part of the bore occupied by, or ahead of, the projectile. The gases escaping past the projectile can only act at any given point in the bore while the projectile is passing that point. The gases confined behind the projectile act at any point in the bore for the whole time occupied by the projectile in passing up the remainder of the bore, an interval on the average at least ten times as long. For these several reasons, we may conclude that the major part of the erosion is due to the action of the gas confined behind the projectile.

While it is true that the remedy proposed in the editorial will eliminate that part of the erosion due to the rush of gas by the projectile, it is also true that the experiment has been tried in practically every country with unsatisfactory results. It is easily possible to construct a device which will practically prevent any gases from escaping past the shot as it rushes up the bore. But although the erosion is reduced, the most of it still remains. We must seek elsewhere for the cure of the difficulty.

One way out of the difficulty would be to dispense with the rifling, making the gun smooth-bored, and adopt some other method of giving the requisite rotary motion to the projectile, as was done in the case of the pneumatic dynamite gun developed by Zalinsky. The smooth bore would be less subject to erosion, and the effects would be less serious on the accuracy of fire. Another method that might be successful would be the reduction in temperature of the gases by the use of some inert volatile solid in connection with the powder, such as ammonium carbonate. A larger weight of charge would thus be required to produce the same volume and pressure of gas, but the lower temperature would make the gas less erosive.

The writer is of the opinion, however, that the best solution of the difficulty lies in the use of high-speed steel for the material of inner tubes. Since the gas developed by modern powders is oxidizing in its tendency, high-speed steel would be especially valuable in this case, in that it is almost impossible to burn it. Since high-speed steel maintains its strength and hardness at a dull red heat, it is especially adapted to the service demanded of the inner tubes of guns. Since it is able to withstand the tremendous wear involved in cutting operations, at such speeds that both tool and chip approach the temperatures of the inner wall of a gun, it would seem to follow that it is the proper material to withstand the wear of the rushing gases and projectile. So far as the writer is aware, nothing has been done along this line, and it would seem to be the part of wisdom for the government to try the experiment upon a gun of small caliber.

There are objections to the use of this steel for this purpose, such as high cost of material and of working. However, if its use would double the life of the gun, it would be a profitable investment. Add to this the fact that the use of this steel offers an opportunity to very largely increase the power of the gun, and we must conclude that even with the same life of gun, the proposed weapon would be far the cheaper, considering its power.

FORREST E. CARDULLO.

Syracuse, N. Y., September 14, 1906.

Restoration of Color of Hair After Treatment With Roentgen Rays.

Dr. Imbert, professor in the medical faculty at Montpellier, and Dr. Marquès, his head laboratory assistant, have been busying themselves daily with medical applications of X-rays. They were tolerably surprised to find that the beard and hair (which were almost white) of one of them were progressively becoming colored, to the point even of shortly assuming a hue deeper than the original one. On the other hand, in the case of a man of fifty-five whom the two professors treated with X-rays for a lupus affecting the left cheek, the hair turned strongly gray. During the first months of treatment they had refrained from limiting by a screen the surface to be irradiated. The hair for several centimeters around the left ear, fell; of the hairs of the mustache, further withdrawn from the blister, no appreciable irradiation was noticed. The hair grew almost black again near the ear, its color plainly weakening in proportion to the distance from it. Likewise the left half of the mustache had assumed a hue less white than the right half. The hair has not been subjected to the X-rays for several months, and it is frequently cut; but it remains black. Other observations authorize Messrs. Imbert and Marquès to declare that under the influence of X-rays, light hair assumes a deeper shade. This last attribute will no doubt be little utilized by young women; but the new process which permits of no longer growing gray in growing old will be highly appreciated by both sexes, if new investigations establish definitely its usefulness and harmlessness. However, physicians alone will have the right to dye hair in this manner; for a recent decision of the Académie de Médecine has reincluded the use of X-rays in the category of medical practices forbidden to the vulgar. Still, everyone will reserve the right of "coloring" himself; but extreme prudence is requisite in the matter.—L'Illustration.

The Current Supplement.

The current SUPPLEMENT, No. 1604, contains an unusual amount of valuable matter. It opens with a well-illustrated and excellently written description of the gigantic irrigation project which has been undertaken by the Canadian Pacific Railway, and which will involve the expenditure of $4,000,000. Elihu Thomson presents his views on the nature and origin of volcanic heat. Prof. J. A. Ewing writes on the structure of metals. The splendid treatise on the modern manufacture of alcohol which was begun in the last number is continued. In this installment the subjects taken up are the preparation of the must from various agricultural products, and the fermentation of the wort. The article on large electrical and steam locomotives is concluded. Robert Grimshaw writes on the industrial applications of gypsum. The English correspondent of the SCIENTIFIC AMERICAN describes a depth indicator for torpedo boats. Edwin J. Prindle's excellent analysis of the art of invention is concluded. Joseph Eysséric gives the results of his experiments with wind shields, and tells how he successfully used one type of wind shield on an automobile.

During the twelve months ending June 30, 1906, the value of American automobiles exported was $3,497,016, which is a million dollars more than during the previous year. Of a little more than half a million dollars' worth of cars that were exported during June, England took the greatest proportion, $194,709, with British North America second, Mexico third, and France fourth.

MACHINES IN THE ELIMINATION RACE FOR THE VANDERBILT CUP.

Our illustrations show six out of the eight different makes of machines which started in the Vanderbilt Cup elimination race on the 22d instant. This is the second time that sufficient American machines have been entered to make necessary an elimination race for the selection of the five cars that constitute the American team. Out of fifteen entries there were twelve starters, and three of the latter succeeded in finishing. A description of some of these machines, and a paragraph telling the result of the race, will be found below.

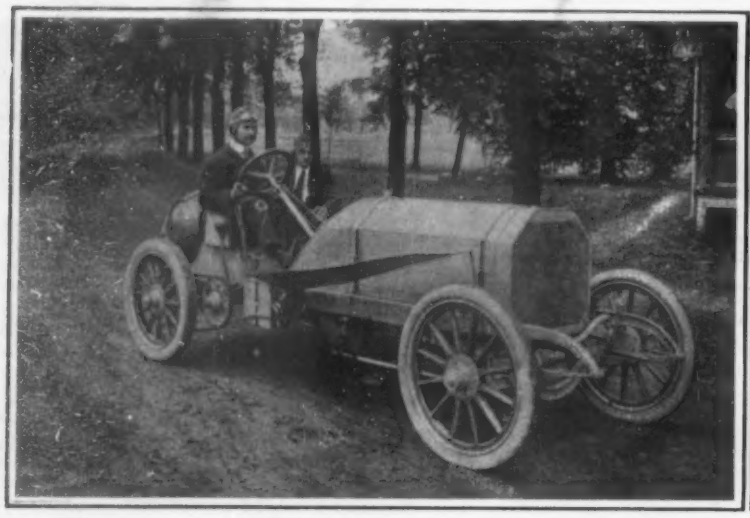
The race consisted of ten rounds of the 29.71-mile course. The course has eleven sharp turns, and a number of stretches of winding road, besides several hills having a grade as high as 10 per cent.

The machine that won the 1905 elimination race was a four-cylinder, 60-horse-power Pope-Toledo. The Pope Manufacturing Company also entered a six-cylinder machine of 90 horse-power in last year's event, but this car did not fulfill expectations. Consequently, the makers have decided this year upon a four-cylinder racer of 120 horse-power. The cylinders have a bore of 7½ inches, and the stroke of the pistons is 6¾ inches. This engine develops its full power at 1,200 R. P. M., at which speed of the motor the car travels 100 miles an hour upon the fourth speed. A clutch of the multiple disk type is employed. The transmission is of the selective type, there being two main sets of bevel driving gears, so that a direct drive is had on both the third and fourth speeds. The first three speeds are 25, 50, and 75 miles per hour at full speed of the engine. High-tension magneto ignition is used, the spark plugs being located in the side of the cylinders just below their heads. The cylinders are cast in pairs, and fitted with copper water jackets. Besides the regular mechanical oiler, there are special oil pumps for forcing oil into the crank case. The car is fitted with Hess-Bright ball bearings in the wheels, but plain bearings are used in the engine and transmission. The wheel base of the car is short, being only 104 inches. The wheels are 32 inches in diameter, fitted with 3½-inch tires in front and 4½ in the rear.

The Locomobile racer finished second in last year's elimination, and obtained third place in the Vanderbilt race itself. This year two complete racers were built by the Locomobile Company after the designs of Mr. A. L. Riker. The new machines are somewhat more powerful than the 1905 racer, and they accelerate much faster. The engines have a bore and stroke of 7¼ and 6 inches respectively, and the rated horsepower is 110 at 1,100 R. P. M., at which speed of the engine the car travels about 100 miles an hour. Copper water jackets are used again, owing to their light weight and the ease of casting the cylinders. These are cast in pairs, as heretofore. The magneto and make-and-break igniters, together with an 8-volt storage battery for starting, form the ignition equipment of this machine. The carbureter has a balanced piston throttle valve, which does away with any sticking of the valve and makes it easy to operate. The engine is lubricated by a series of small hand pumps placed on the footboard, so that they can force oil directly from the tank (which is behind the latter) to the bearings and crank case of the engine. These racers are provided with a leather-lined cone clutch of large diameter, which is thoroughly incased and protected from oil. A positive clutch consisting of pins which slip into holes on a plate attached to the flywheel is also provided. This can be slipped in after the cone clutch has taken hold. A three-speed sliding-gear transmission of the usual Locomobile type, but having its shafts mounted on ball bearings, is employed. The wheels also run on ball bearings of the single-ring silent type. The wheel base of the racer is 120 inches, and it is fitted with 3½ by 34-inch tires in front and 4½ by 34 in the rear. The usual double chain drive to the rear wheels is employed. Expanding ring emergency brakes are fitted to the rear wheels, and a pedal-operated band brake to the differential.

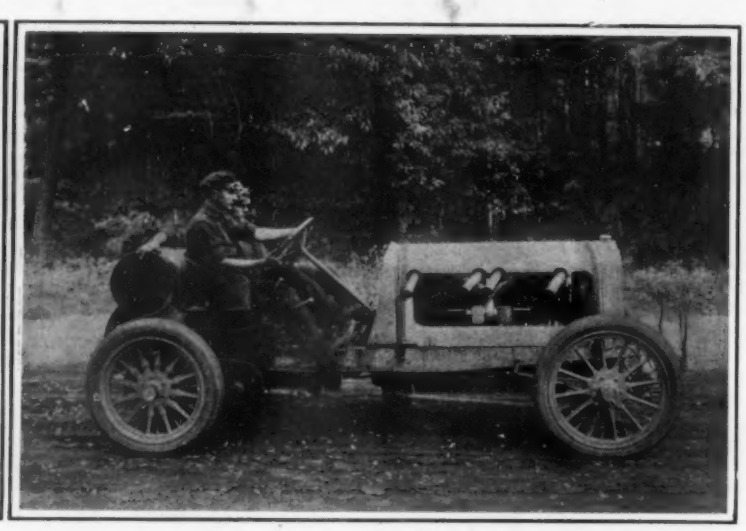
The Thomas firm, which also tried a six-cylinder racer last year, has this year returned to the four-cylinder type of motor, and has built no less than three powerful racers of 115 horse-power, all three of which started in the elimination event. The engines of these racers have 6⅞ x 5½-inch cylinders, and at 1,300 R. P. M. they drive the car 100 miles an hour. As can be seen from the illustration, the Thomas engine is one of the most clean-cut engines on any of the cars. Each pair of cylinders is an integral casting. The inlet valves are placed directly over the exhaust valves, and are opened downward by means of horizontal lever arms worked by vertical push rods from the single cam shaft. Magneto ignition by a special form of high-tension magneto is the only system used. If the magneto becomes disarranged, there is no chance of running the car upon batteries. The engines are provided with mechanical oilers chain-driven from the cam shaft. No fan is used behind the radiator, the natural draft being depended upon. The transmission furnishes three speeds, and is of the selective type, each speed being obtained by selecting one of three sets of pinions. A direct drive to the countershaft is furnished on all three speeds. The final drive is by double chains to the rear wheels. A large cone clutch with positive supplementary locking device is used, and a double universal joint is fitted between the engine and the transmission. All three of the Thomas racers have their rear wheels fitted with removable rims, so that all that is required to change a tire is to remove six nuts, take off the rim, put on a new one, and replace the nuts—an operation that can be accomplished in a couple of minutes with the aid of special socket wrenches.

The most novel and distinctively American type of car in the elimination trial was the Frayer-Miller. Three of these machines were entered, and all started in the race. These cars are remarkable from the fact that their engines, which have the same bore and stroke as those in the Locomobile racer, viz., 7¼ x 6 inches, are cooled entirely by air, which is forced by a powerful gear-driven blower, located in front of the engine, through a casing extending over the tops of the cylinders and connecting with aluminium air jackets. That this method of cooling has been applied successfully to so large an engine speaks volumes for American ingenuity. These machines were built by the Oscar Lear Automobile Company with the idea of demonstrating to a finish the air-cooled principle. They are without exception the largest air-cooled cars ever constructed. In order to make these cars as light as possible, their designer, Mr. L. A. Frayer, built them with tubular axles and wire wheels. After a number of practice trials had



Tracy and Poole on the Winning Locomobile Racer.

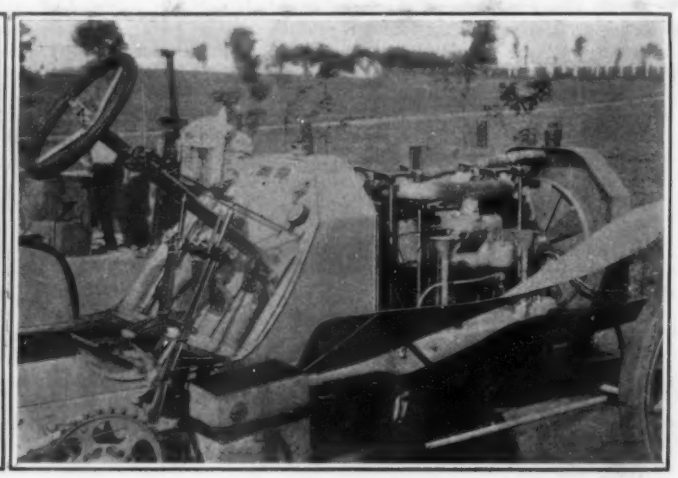
Despite the trouble on the first round, the machine gained steadily and won in 5 hours, 27 minutes, 45 seconds. The fastest round of the 29.71-mile circuit was made in 59 minutes, 29.6 seconds.



Lytle and Dingley on the Pope-Toledo Racer.

Three tires of this car were replaced on the sixth round. Trouble was also experienced with the radiator leaking. The car was in fourth place on its final round when the race was stopped.

The 60 H. P. Haynes Car, Which Finished Third in 6 Hours, 25 Minutes, 39 Seconds.



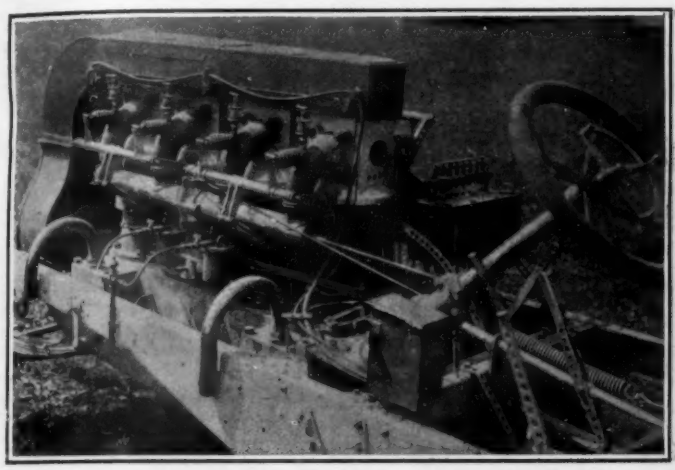
The Engine, Control Levers and Footboard of the 110 H. P. Locomobile.

SOME OF THE WINNING MACHINES IN THE VANDERBILT CUP ELIMINATION TRIAL.

been made on the course, however, he found that the wire wheels would not stand the strain of the many sharp turns. Consequently, wooden wheels were substituted. The drive of all three cars is by means of a propeller shaft and live rear axle of the floating type, in which the weight is all carried upon the tubular outer axle. The wheels are fitted with both internal and external band brakes, which are applied to a drum on the metal hub. The engines of these cars are made up of four separate cylinders, having the inlet and exhaust valves placed horizontally in the cylinder heads and on opposite sides of the cylinders. The ignition is by means of batteries and coils.

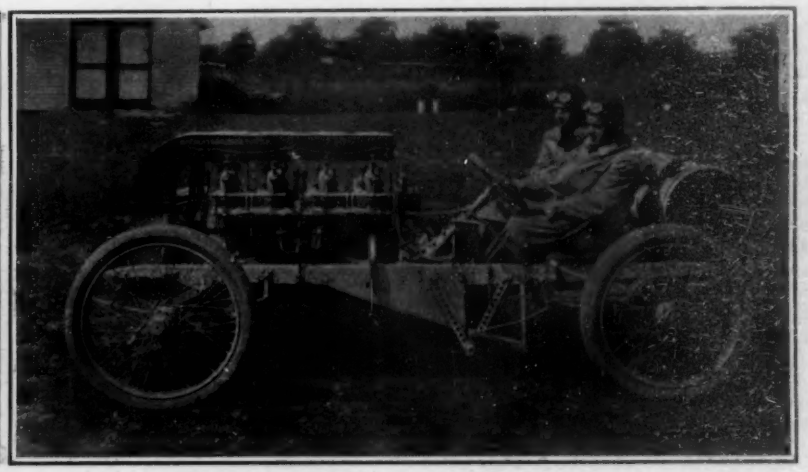
The transmission of the Frayer-Miller cars is of a new type known as the Belden change-speed gear. for operating the make-and-break igniters. These igniters are very simple in construction, and allowance is made for a considerable amount of wear. There is an ingenious arrangement which makes it possible to start the motor from the seat by pushing a round disk seen on the rear of the dashboard near the floor. This disk is on a special cam shaft extending across the engine, and by pushing it and releasing it suddenly, the proper igniter is snapped and the engine starts. The transmission of the Matheson car is of the selective type, giving four speeds forward. There are two sets of bevel driving gears, thus affording a direct drive on both the third and fourth speeds.

The clutch is of the multiple-disk type, and contains cylinders have the inlet and exhaust valves located symmetrically on opposite sides. The engine is rated at 80 horse-power at 800 R. P. M. Two radiators are used, one in front of the engine, and the other just back of it. The water circulation is on the thermo-siphon principle. The clutch is of the multiple-disk type, the disks having a 6-inch working face and are 1-16 of an inch thick. A pressure of 600 pounds to the square inch is obtained from the clutch spring. This clutch is exceedingly small, and is completely incased in the transmission gear box, which contains a set of gears giving three speeds forward and a reverse. The drive is by propeller shaft to the live rear axle. The entire eight cylinders of the motor are supplied from a single carbureter.



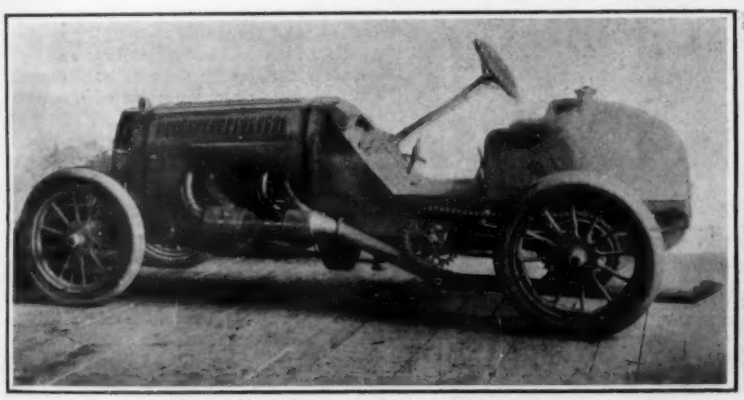
The Largest Air-Cooled Automobile Engine Ever Constructed.

The cylinders (of 7¼ inch bore by 6 inch stroke) are cooled by air from a blower located in front. Note the double carbureter and the mechanical oiler at the right.



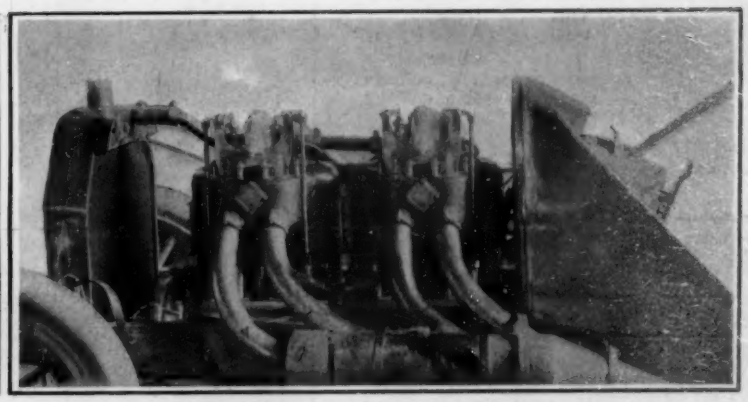
The Frayer-Miller 110 H. P. Air-Cooled Racer.

One of these cars was on its ninth round and was running in sixth place when the race was called off.



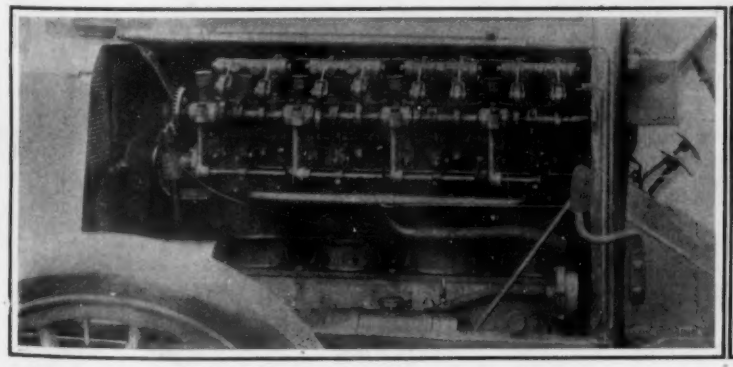
One of the Three 115 H. P. Thomas Racers.

Thomas Car No. 6, driven by Le Blon, obtained second place in 5 hours, 51 minutes, 25 seconds.



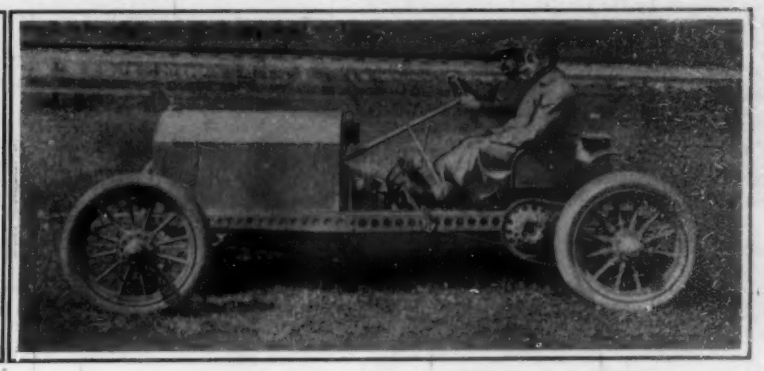
The Valve Side of the Thomas Engine.

No fan is used behind the radiator of this car. The valves are all on one side, mechanically operated.



The 60 H. P. Engine of the Matheson Car.

Valves in the cylinder heads operated from a single exposed camshaft, together with make-and-break igniters fed by a magneto, are the distinguishing features of this engine.



The Matheson Stock Racer.

This car was eliminated on its first round owing to a burst tire causing it to swerve and run into the ditch.

SOME OF THE WINNING MACHINES IN THE VANDERBILT CUP ELIMINATION TRIAL.

This type of transmission consists of a series of roller bevel pinions that engage circular sets of pins on the driven member. The chief advantage is that a direct drive through one set of bevels is had on each speed. Consequently, there is no loss of power in driving through a number of gears. The transmission and wheels of these cars are mounted on ball bearings.

The Matheson racer is in reality a regulation stock car of 60 horse-power. The engine is of the standard four-cylinder vertical type, with both inlet and exhaust valves located in the cylindrical heads of the cylinders and operated by rocker levers from a single cam shaft located near the tops of the cylinders. This cam shaft is driven from a vertical shaft by means of bevel gears. The cam shaft is also fitted with special spiral cams fifty-one steel disks running in oil. Hess-Bright ball bearings are fitted to all the wheels, as well as to the transmission and the differential and sprocket shafts. The weight of the car is well up to the limit of 2,204 pounds. As the frame was much heavier than the designer specified, it was drilled full of holes to lighten it. The engine develops its maximum power at 1,200 R. P. M., at which engine speed the car makes 90 miles an hour. The dimensions of the engine are 6 inches bore by 6 inches stroke. The car has the usual side chain drive to the rear wheels, and the latter are fitted with expanding ring brakes.

The Maxwell eight-cylinder racer was damaged before the race and did not start. The bore and stroke of the cylinders are each 5 inches. The

The Haynes machine is the stock car with a racing body. The engine is rated at 60 horse-power, and has a 5¼-inch bore by a 6-inch stroke. At 1,200 R. P. M. it drives the car over 75 miles an hour. The Haynes car made one of the best performances in the last elimination race, it having obtained fourth place. The present car has many of the features that were first brought out on last year's racer.

Still another stock machine was the Oldsmobile 40 to 45-horse-power car. This car met with several accidents during the practice spins on the course. It is merely the chassis of the standard stock car, and it has been lightened as much as possible for the race.

Both the 110-horse-power Christie front-drive racer and the 80-horse-power Apperson racer were demolished

by crashing into telegraph poles a few days prior to the race. Neither Walter Christie nor his mechanic was badly hurt, but Robertson and his man were seriously injured. Christie stripped his recently completed 50-horse-power touring car, fitted on a racing body, and started ninth in the race.

The result of the elimination race was as follows:

Tracy, on the 110-horse-power Locomobile, first in 5 hours, 27 minutes, and 45 seconds—an average speed of 54.38 miles an hour.

Le Blon, on the 115-horse-power Thomas, second in 5 hours, 51 minutes, 25 seconds, or an average speed of 50.73 miles an hour.

Harding, on the 60-horse-power Haynes, third in 6 hours, 25 minutes, 39 seconds, or an average speed of 46.22 miles an hour.

During the first few rounds the race was a close one between the Pope-Toledo, the Locomobile, and Le Blon's Thomas. The Locomobile had tire trouble in the first round, which caused it to assume sixth place, but it kept gaining on each subsequent lap till, at the end of the fourth (which was made in 29.48) it held first place. At the end of the fifth lap it had fallen back to third place, Le Blon's Thomas being first and Lytle's Pope-Toledo second. The remainder of the race was a battle between Tracy and Le Blon for first place. The former held it at the end of the sixth lap, and the latter regained it at the end of the seventh and eighth, only to lose it finally during the ninth round. From fourth place at the end of the fifth lap, the Haynes moved to third at the end of the sixth, and held this position to the end of the race. The Pope-Toledo was second at the completion of half the race, but an inordinate amount of tire trouble on the sixth round caused it to drop back to fourth place, in which position it was running (having completed nine rounds) when the race was called off. Walter Christie had finished his eighth lap and was on the ninth and holding fifth place when the race was stopped. Frayer-Miller No. 11 was sixth, and was the only remaining car running.

By obtaining third place the Haynes car gained new laurels for steady and consistent running. Its average speed was not quite as high as that made last year, but it was one place ahead of that obtained last year at the finish. None of the other stock cars made a favorable showing. Of the two teams of three cars each—the Thomas and the Frayer-Miller—but one car of each team succeeded in finishing or in keeping going till the race was called off.

The result of the eliminatory race seems to show that the American team will have but one racer that is in the same class with the foreign machines, and that can be depended upon to run steadily without breakdowns and yet have sufficient speed to make up time lost by tire trouble. That only a racer of this description will have any chance in the Vanderbilt race on October 6 seems to have been proven by the results of that race last year. It is to be hoped that the one representative American racer will finish the race proper in the same position in which it finished the elimination.

The Insulation of Insulators.

Commencing with the green bottle glass telegraph insulator, the size of a tea-cup, about ten years ago, the electric power-transmission engineers have been steadily increasing the size and cost of their high-tension insulators, until now they are using huge glass or porcelain insulators, the size of a cabbage. According to the Electrical World, there has been no help for this visible swelling of the insulator. The little ones simply would not stand the electric stress, as the electric pressure rose by leaps and bounds. Even now the manufacturers would be ready to risk constructing transformers for one hundred kilovolts if the line engineers would accept that pressure. Perhaps the line engineers may do so before long. The question is what will their insulators then be? Will they be as large as umbrellas? Is long-distance transmission to be limited by the cost of conductors, or by the cost of insulators? A new suggestion is offered from Italy. Instead of placing the high-tension conductor on the top of the insulator, and arranging a series of porcelain petticoats beneath, so that a beetle would have to walk some 60 centimeters in the shortest path over the surface from wire to pin, the new insulator hangs the wire underneath the topmost petticoat which is expanded into a relatively thin umbrella.

The purpose of the umbrella is only to shelter from rain and not to insulate; so that the umbrella can be made light and inexpensive. The actual insulator below the umbrella is stated to be considerably smaller than would be necessary in case the umbrella were removed.

SOME REMARKABLE RESULTS WITH ARMOR-PIERCING SHELLS.

During the past year some interesting experiments with a new type of armor-piercing shells have been carried out by the British government authorities. This new projectile, known as the "Heclon," is the product of the Hadfield Foundry, of Sheffield. They are of the "capped" type, and the results obtained therewith have exceeded anything previously accomplished. The projectiles of 2½ per cent bursting capacity range in caliber from 4⅛ inches to 12 inches, and have successfully pierced Krupp cemented armor plates ranging from 5 inches to 12 inches in thickness without breaking. The results achieved are as follows:

	Plate, Inches.	Striking Velocity, Foot-Seconds.
4⅛-inch projectile perforated	5	1900
4.7-inch projectile perforated	6	2100
6.0-inch projectile perforated	6	1990
7.5-inch projectile perforated	7	1980
9.2-inch projectile perforated	9	2033
12.0-inch projectile perforated	12	1981

In Spain equally successful results have been achieved, and the makers have completed the unit of large caliber capped shell for the Spanish navy. A supreme test was imposed upon one of these shells upon the proving grounds of another important European power. In this case the plate to be attacked consisted of a 12-inch Krupp cemented armor plate backed with 12-inch oak and three ½-inch skin plates. Instead of firing a 12-inch projectile, as is generally done, at such a plate, a 10-inch Heclon projectile was utilized, being fired at the low velocity of 1,877 foot-seconds. The shell perforated the plate and backing, and, despite the severity of the test, the projectile was found with only two small pieces of the shoulder broken, no less than 2,600 feet beyond the target. These projectiles have been adopted by the British authorities, since they have been found to excel other types in their penetrative capacity without breaking.

"HECLON" ARMOR-PIERCING CAPPED PROJECTILES RANGING FROM 4⅛ INCHES TO 12 INCHES.

The photograph shows the shells after they perforated armor plates varying in thickness from 5 inches to 12 inches.

It is reported by the Vienna journals that a party of Dalmatian fishers, when drawing up their nets from a depth of 100 feet or more, brought up an interesting object in the shape of a cutlass, coming no doubt from a long-sunk wreck. Judging by the crustaceous deposits which partly covered the blade, it must have lain at the bottom of the Adriatic for many years. The fishers in question brought their discovery to Spalato, and an army officer saw it and purchased it for a small sum. The officer then sent the cutlass, still covered with crustacea, to the Minister of Marine. After examining it carefully, it was found that the hilt was in a very good state of preservation. This arm apparently belonged to the navy, and it is thought by some authorities that it may have been used on board the frigate "Radetzky," which was sunk in 1869. At present the weapon is to be seen at the Imperial and Royal Marine Museum at Pola.

The Luscious Red of the French Cherry—Its Chemical Genesis.

Consul-General Robert P. Skinner, of Marseilles, was asked by a California correspondent to ascertain by what method French *glacé* or preserved cherries are dyed, as they command a higher price than California cherries in the American market "solely on account of color." The inquirer adds that French cherries possess "a beautiful deep-red color that is bright and clear, although they lack the flavor of the home-grown fruit. We could increase our sales many fold if we could color our cherries artificially as they do in France." Mr. Skinner replies:

French candied cherries are first bleached with sulphurous acid and then dyed in the course of manufacture with an aniline preparation known commercially as "rose nouveau." In former times carmine powders made of cochineal were used, and are still in use in a limited way for very superior products, but the aniline color is cheaper, and I am notified by four of the leading houses exporting to the United States that they use the cheaper material. One of these four houses writes as follows:

"The fruits invoiced by us are colored with 'rose nouveau,' a dye authorized in France after analysis by the Municipal Laboratory of Paris. All our labels bear the mention 'artificially colored,' to conform to the American custom-house regulation. The boxes of 'chinois verts,' plums, and angelicas, although containing no coloring matter, bear the mention 'colored with sulphate of copper,' in order to prevent any possible difficulty with the customs." The "rose nouveau" is a methylated and ethylated derivative of coal tar. "Rose nouveau" is likewise utilized in the manufacture of colored biscuits, sometimes alone and sometimes mixed with dry carmine.

The consul suggests that the future of California preserved fruit and every other natural product may be improved in the long run, if the packers will carefully refrain from the exercise of those merely decorative arts presumed to appeal to the public taste. It may be doubted if any great portion of the consuming public is either deceived or flattered by the artificial gorgeousness of fruits which have been boiled until their natural color has departed and then dipped in aniline dye. Though the preparation may be perfectly harmless, it certainly contributes nothing to the excellence of the finished article, and the knowledge of these facts tends to hold in check the public demand.

The use of sulphur bleach upon thin-shelled almonds has actually diminished the demand for these nuts in France, for the reason that the kernels are sooner or later affected, acquiring an acrid taste which nobody likes. As applied both to almonds and walnuts the sulphur bleaching process is, furthermore, frequently a species of mild fraud, as it enables the dealer to mix nuts of old and new crops and different countries, give them the same shade, and get the same price. It is presumed that public taste requires a nicely bleached nut, although no intelligent individual really objects to the honest color of a walnut or almond shell, especially when that color may be taken as a guarantee of the quality of the kernels.

Vice-Consul Brown sends from Lyon the following directions for coloring cherries:

The fruit is selected, washed, stemmed, and spread upon slat frames of wood underneath which at intervals basins of sulphur are placed; the cherries are subjected to the fumes of the ignited sulphur until they are of a uniform color, which is usually yellow. A quantity of the coloring matter (rose nouveau) is dissolved in a liter of cold water. Then the cherries are placed in an earthen pot with a little of the coloring liquid, dissolved sugar, and glucose, glucose being used only in sufficient quantity to prevent crystallization and souring and to keep the fruit soft. The mass, after mixing, is turned into copper kettles and boiled slowly for about ten minutes. It is then all turned back into the earthen vessel and allowed to cool for two or three days to permit the coloring matter to permeate the fruit. If the color is not as desired a very little more coloring matter is added and the above process is repeated sometimes fifteen or twenty times, or until the desired color is obtained and the *glacé* process finished.

One and one-half kilos (kilo = 2.20 pounds) of this coloring matter is sufficient to treat 10,000 kilos of cherries. The fresh cherries cost about 6 to 7 cents a kilo and after being treated by this process they are sold at 36 to 42 cents per kilo.

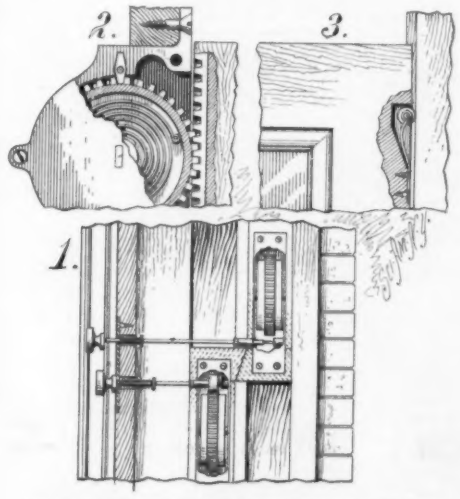
The Duke of the Abruzzi has named the three highest peaks of Mount Ruwenzori after Queen Margherita, Queen Alexandra, and King Leopold.

AN IMPROVED WINDOW RAISING AND LOCKING DEVICE.

An ingenious window raising and locking device has been recently invented by Mr. Archibald Nesbett of the Fuller Construction Company, of New York, and Mr. Frans Bruno, of Brooklyn, which possesses all the merits of the several parts heretofore necessary to operate the sash in double-hung windows, besides being more economical. The device combines in itself that of sash weights, chain, pulleys, locks and lifts, and does away with the necessity for box frames with weight pockets. It can be attached in a fraction of the time usually required to hang a pair of sash, and is very simple and efficient in operation.

It is often desirable to lock a window sash open sufficient to permit ventilation, and yet be secure from intrusion of burglars and sneak thieves. This can be accomplished with this device, as it provides for absolutely locking either or both sash in any desired position.

The accompanying engraving illustrates the mechanism of the invention. In the pulley stile of the window is a drum, very similar to that of an ordinary pulley, which incloses a coil spring, one end of which is attached to a fixed shaft on which the drum revolves; the other end is secured to the drum. The drum is provided with gear teeth which engage a rack in the sash, as shown in Fig. 2. This is applied to both sash, and when a sash is moved to a closed



AN IMPROVED WINDOW RAISING AND LOCKING DEVICE.

position, it winds up the spring and is held in position with the lock; when the lock is released the sash automatically raises. To lock the sashes, a key is provided for each sash; this operates the lock which fits between the teeth in the drum and is held in a locking position by a spiral spring, but it may be withdrawn and by half a turn prevented from slipping back into engagement with the teeth, as shown in Fig. 1.

The entire device, when installed, is invisible, except the small keys which are exposed on the turn at the party rail.

Considering the economy, simplicity of operation, and efficiency, the device should readily recommend itself.

Patents as a Factor in Manufacturing Business.

Under this heading, in the September number of the Engineering Magazine, Edwin J. Prindle, of the New York bar, furnishes some very useful information in untechnical language for the benefit of business men. The value of a patent as the best and most effective means for controlling competition is strongly emphasized. The United Shoe Machinery Company, the Westinghouse Air Brake Company, and others are cited as corporations whose commanding position is dependent largely upon patents, and the Bell Telephone Company is quoted as a corporation which, even though it is not now dependent upon patents to any great extent, yet controls the situation, owing to the fact that it was permitted to locate itself and obtain a practical monopoly in many cities during the seventeen years in which its principal patent was active. "Patents are the only legal form of absolute monopoly," says Mr. Prindle, "and they are absolute so far as they go. In a recent decision the court said, 'Within his domain the patentee is Czar. The people must take the invention on the terms he dictates, or let it alone for seventeen years. This is a necessity from the nature of the grant. Cries of restraint of trade and impairment of the freedom of sales are unavailing, because for the promotion of the useful arts the constitution and statutes authorize this very monopoly.' The possession of suitable patents is, therefore, of great importance to the manufacturer. On the other hand, it is equally important to the manufacturer whose competitor has patents, to understand what limitations, if any, there are to his competitor's advantage, and how, if at all, a counter-advantage may be gained." Considerable confusion is apt to arise in the minds of laymen as to what constitutes a patentable invention. There are four classes of inventions for which patents are granted, namely, arts, machines, manufactures, and compositions of matter. An art may be any process or series of operations for accomplishing a physical or chemical result; for instance, the casting of car wheels, in which a jet of molten metal enters the mold in a tangential direction, producing a whirling motion which causes sound metal to float to the rim of the wheel, thus preventing cinders and bubbles from occurring in the rim. The patentability of the process is not affected by the fact that no new mechanism may be required. It is at this point that the manufacturer is often misled into thinking that there is no patentable invention present.

"A machine is any assemblage of mechanical elements having a law of action of its own." The definition covers a jack knife as well as a steam engine.

An article of manufacture is anything made by hand that is not an art, machine, or composition of matter; for instance, a safety pin, tooth brush, etc.

Composition of matter is any mixture or combination of chemical elements, such as calcium carbide from which acetylene is made, acetylene itself, a soap, or a tool steel.

"A new combination of old elements may be patentable, if it produces a new or improved result, or an old result in a new way. A new form of an element of a combination that is old, as a whole, may be patentable. Improvements and attachments on old machines may be patentable. A new use of an old device, or machine or process, may be patentable, if the new use is so different from the old use as not to be obvious to an ordinary skilled workman in the art.

"The grant of a patent purports to give the inventor the right to make, use, and sell the invention; but in legal effect it really gives him only the exclusive right to prevent others from making, using, and selling the invention. If his invention happens to embody the principle of some invention that is covered by a previous patent, the owner of the previous patent can prevent the making, using, and selling of any embodiment of the later invention using the earlier principle, and the later patentee must either make terms with the earlier patentee, or wait until the earlier patent is dead. But the later patentee can prevent the earlier patentee or anyone else from using the later invention during the life of the later patent."

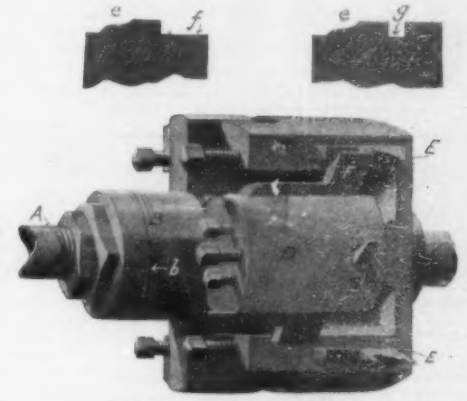
Regarding the claims of a patent, Mr. Prindle says that there is no piece of English composition that is more generally misunderstood, yet the general nature of the claim is not beyond the comprehension of the layman. A strange thing about a claim is that the more it says, the less it means. Suppose the claim to be a bill of sale giving title to cattle on a large Texas ranch. "If it gives title to all the short-horn Durham steers having one white forefoot and three red feet, the purchaser would get very few cattle. If, however, the bill of sale gave title to all the live stock on the ranch, the purchaser would not only get all the short-horn steers with only one white foot, but he would get all the steers of every description and all the heifers, bulls, horses, and pigs that there might be there. The mistake arises from supposing the best form of claim to be a detailed description of the particular embodiment of the invention shown in the patent, when it should be a description of every class of machines which embodies the principle of the invention, whether or not the details not essential to that principle are copied. In other words, the claim is not a list of elements whose virtue is greater the larger the number of elements enumerated; but it is the description of a class of combinations of elements, and the fewer elements stated the larger the class of machines is likely to be in which that combination of elements is found.

"The Supreme Court of the United States has said that the claim of a patent is one of the most difficult pieces of English composition to write. It is often thought that the particular wording of a patent is not important, the skill required being in enforcing the patent in court; but it must now be clear that there is great opportunity for skill and foresight in drawing the patent. A well-drawn patent may make plain sailing in court, while a poorly-drawn patent often has a hole in it through which serious competition can escape."

Exports of coal and coke from the United States in 1905 aggregated over $31,000,000 in value, against $11,000,000 for 1895, a decade earlier. The United States holds third place among the nations as an exporter of coal, and first place as a producer.

AN IMPROVED CUTTER HEAD.

Pictured in the accompanying engraving is an improved cutter head of the type adapted for the making of window sash. The principal features of the invention consist in the convenient arrangement of the cutting blades or plows and in the provision of means for adjusting the head, so that both stiles and rails of sash of various widths may be cut. Our engraving illustrates in section the form of window rail and stile made by the cutter. The cutter head comprises an arbor *A*, on which is mounted the member *C*. This member, at one end, abuts against a collar, while the opposite end has the form of a sleeve or tubular projection, on which the member *B* is mounted. The latter is formed with a transverse bar adapted to engage slots in the face of member *C*. A cap and a series of washers bear against the outer end of member *B*, and a pair of set nuts threaded on to the shaft against the cap serve to hold the two members in relative position. The member *C* is laterally slotted at opposite sides to receive the plows *L*. These are held securely by gibs, which are pressed against the blades by means of set screws. Projecting from opposite sides of the member *B* are a pair of auxiliary heads *D*, which are slotted to receive the plows *F*. The latter are also held by gibs and set screws. The plows are mounted diagonally, so that their cutting edges will partly overlie the cutting edges of the plows *E*. The heads *D* also carry the plows *G*, which overlie the plows *E*. It will be observed that the plows *E* are channeled, so that their cutting edges have the form of the usual window moldings. In use the cutter head is mounted in the machine in the ordinary way, and rotated. The plows *E* will then cut away the rails or stiles to the form *e*, while the plows *F* and *G* will cut the rabbet *f* of the rail; or, if the plows *F* are withdrawn somewhat, they will smooth off the side bar of the stile, while the plow *G* will cut the glass and putty groove *g*. In stock sizes of sash the molded portion is commonly of the



AN IMPROVED CUTTER HEAD.

same thickness for all, while the thickness of the center bar, rabbet, and side bar varies. In order to allow for these variations, the washers *b* may be added to or removed, and similar washers added to or removed from the space between the members *B* and *C*, thus adjusting the plows *F* and *G* with respect to the plows *E*. A patent on this improved cutter head has recently been granted to Mr. Monroe Button, of Fort Plain, N. Y.

Government Investigation of Rodent Epidemics.

It is well known that many species of rodents which live in colonies, such as prairie dogs, spermophiles, field mice, and rats, are subject at irregular intervals to microbic diseases in the nature of epidemics, which greatly reduce their numbers. The Department of Agriculture desires to be informed of the presence of such epidemics, with a view to conducting investigations regarding the isolation and preservation of the microbe for use in destroying mammals injurious to agriculture. The Department, therefore, requests that it be informed where possible by those noticing such epidemic diseases among the wild animals of the character specified, now or at any future time. Such diseases are usually indicated by the presence of numerous sick or dead animals. The investigations on these lines should prove of great value to agriculturists throughout the country, and it is to be hoped that farmers and ranchers will take sufficient interest in these proceedings to supply the Department with whatever information it is in their power to forward regarding the question.

Attention has been called to the fact that in evaporating gold or silver solution in a porcelain basin, a considerable amount of gold or silver may be absorbed by the porcelain itself. In the manufacture of chloride of gold it is customary to grind up all of the porcelain evaporating basins, from which some of the deficiency is recovered.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 8371.—Wanted, the address of the manufacturers of the Munson typewriter.

For hoisting engines. J. S. Mundy, Newark, N. J.

Inquiry No. 8372.—Wanted, tubing butt seam or lap seam, ¼ inch outside diameter, No. 24 gauge B & S, steel or galvanized iron; wanted in 2-inch lengths.

J. C. Sparks, B.C.S., F.C.S., Anal. Chemist. See adv't

Inquiry No. 8373.—For manufacturers of sheet celluloid, folded or pressed into tubes or U section.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 8374.—Wanted, manufacturers of flock machinery.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 8375.—Wanted, a manufacturer of machinery for making confetti.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 15, Montpelier, Vt.

Inquiry No. 8376.—Wanted, manufacturers of machinery for making clock movements; also of those who do metal stamping of clock movement parts.

I sell patents. To buy, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 8377.—Wanted, manufacturers of machinery for making the stamped metal parts of electric snap switches, also those who do stamping of such parts.

Metal Novelty Works Co., manufacturers of all kinds of light Metal Goods, Dies and Metal Stampings our Specialty. 45-47 S. Canal Street, Chicago.

Inquiry No. 8378.—Wanted, manufacturers of spring motors, similar to clock movements but heavier.

The celebrated "Hornsby-Akroyd" safety oil engine. Koerting gas engine and producer. Ice machines. Built by De La Vergne Mch. Co., Fr. E. 138th St., N. Y. C.

Inquiry No. 8379.—Wanted, manufacturers of patent medicines; medicine droppers.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machine work and special size washers. Quadriga Manufacturing Company, 18 South Canal St., Chicago.

Inquiry No. 8380.—For makers of all kinds of cloth.

Inquiry No. 8381.—For makers of phonographs, gramophones and electric novelties.

Inquiry No. 8382.—For makers of shoes, hats, etc.

Inquiry No. 8383.—For makers of cycles, guns, English-made furniture and crockery.

Inquiry No. 8384.—Wanted, automatic distributors for 20 gr. lozenges.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

COMBINED TROUSERS-STRETCHER AND COAT-HANGER.—S. B. BEDNORN, Terrell, Texas. In this case the object is to provide a stretcher formed of resilient wire rods, and a coat-hanger of similar material, these cooperative devices being so combined that the hanger adds to the efficiency of the stretcher when both are employed together, a further object being to so construct the stretcher and hanger that they may be used separately and be equally effective if this is desired.

TAILOR'S MEASURING DEVICE.—A. M. ROLAND, Honolulu, Hawaii. This device is especially adapted for taking measurements for coats and vests. The purpose is to provide a straight-edge adapted to be passed horizontally beneath the arm, carrying a sliding shoulder-conformer and an adjustable scale-arm for the breast, together with a tape-measure pivotally attached to the conformer in such manner that measurements may be taken by the tape measure in any direction from one point.

APPLIANCE FOR INSERTING BEADING IN BOOT AND SHOE WARE AND OTHER GOODS.—ELLEN TOWNSEND, 197 Princes Street, Port Melbourne, Victoria, Australia. By this invention manual labor is saved in the process of inserting beading, commonly called "patent" beading, by sewing or stitching into boot and shoe ware and other goods. According to the improvement the whole of the hand process of fitting and sticking, hammering, and adjusting is rendered unnecessary and the services of the fitter operative are altogether dispensed with and the cost saved.

Electrical Devices.

MEANS FOR TRANSMITTING ELECTRICAL IMPULSES.—F. L. ORR, Thurman, Iowa. Means are provided by this inventor whereby a slight electrical shock is transmitted throughout the entire line of wire fence and through the cattle if in contact with the fence to the ground, the device being so arranged and regulated as to deliver these electrical impulses at short intervals, a speed governing device being provided to secure practical uniformity in the intervals and to prevent the batteries from running down too rapidly.

DISTANT-ACTING ELECTRICAL GAS-IGNITER.—G. LENTSCHAT, Hohen-Schönhausen, near Berlin, Germany. According to this invention a ring is rotated indirectly by means of a gear, although the ring can be directly rotated. The advantages attained are to employ a proportionally low electromagnetic force to rotate the ring, to regulate ad libitum the gas-passages, and to switch a number of gas-flames on one circuit without altering the gas-igniter, so that several flames can be simultaneously ignited and the same be extinguished in series.

Of Interest to Farmers.

ATTACHMENT FOR HAY-PRESSES.—S. H. CHRISTOPHER, Buena Vista, Ga. One purpose of the improvement is to provide a power-head for hay-presses which will be capable of attachment to any press, especially a hay-press, where horse-power is employed and wherein the power-head is light of draft and imparts a long stroke to the plunger-bag and has continuous and direct action on the bar during the pressing stroke of the latter.

COTTON-CHOPPER.—R. A. SLIGH, Sligh, S. C. In this instance the invention relates to cotton-choppers of that type in which a longitudinally-arranged shaft is rotated through bevel-gears by running wheels and said shaft is provided with revolving hoes or cutting-blades that chop transversely across the row of cotton-plants to properly thin them.

Of General Interest.

CURRENT-MOTOR.—C. A. NEYLAND and H. G. NAGEL, Lewiston, Idaho. The invention refers to that class of devices known as "current-motors," and has for its object the utilization of the maximum amount of force that the current in any stream is capable of imparting. The invention is especially adapted for pumping water for irrigation, but may also be used for other purposes.

FENCE OR DIKE.—J. W. HUMPHREY, Woodlawn, Ore. Although applicable to all the purposes of a fence for inclosing land, as farms, lawns, and the like, the invention is equally adapted as a dike or levee for preventing the encroachment of water, mud, silt, and the like upon low-lying lands. It is portable and readily taken apart and put together and quickly erected and repaired from time to time.

CARPENTER'S FRAMING-SQUARE.—L. M. HOBOR, San Jose, Cal. The improvement pertains to carpenter's tools, and especially to the type of tool used by such artisans for laying out bevel-cuts for a saw. The object is to produce a tool of this class, especially useful in the construction and framing of roofs. The special object is to provide a square of such construction that all of the bevels may be laid off from the square after one setting operation.

GARDEN-PLOW.—W. E. HAWKINS, McGaheysville, Va. In this instance the invention is an improvement in garden implements, being especially designed for use in plowing and cultivating small plots of ground such as are commonly used for household gardens. The implement may be pushed by the operator, or a small boy can pull on the front end of the beam by means of a rope.

DEVICE FOR FIRING BLAST CHARGES.—J. DOWD, Chicopee, Kan. This simple and economic device is especially adapted for firing blast charges, but can be used in connection with any form of powder-cartridge. The device is adapted to be imbedded in the powder contained in the cartridge and which after a certain interval of time automatically ignites the powder.

MELTING APPARATUS.—G. CRUISE, New York, N. Y. In the present patent the invention has reference to apparatus for melting such substances as snow and ice, it being particularly adapted for use in disposing of the accumulations in streets. Its principal objects are to provide an effective and convenient apparatus of this character. Fire is started in the heating-chamber, and either solid or liquid fuel may be used, as is convenient.

HAIR-WAVING DEVICE.—A. SCHAREB, New York, N. Y. The aim of the invention is to provide features of construction for a hair-waving instrument which will produce the Marcel wave in reversed order when two of said instruments are used successively, the mainly similar tools being extremely simple, well adapted for self-application to the hair, enabling the quick and reliable production of the peculiar coiffure, and that will avoid injury to the hair or person.

Household Utilities.

COMBINED DOUGH-KNEADING BOARD AND BARREL-COVER.—W. S. LITTLE, Scott, Ark. In the present patent Mr. Little has devised an improved attachment for flour and other barrels which is adapted to serve as a dough-kneading, bread, or pastry board and also as a cover for a barrel to keep out dust and dirt and prevent access of vermin thereto.

Machines and Mechanical Devices.

WIRE-STRETCHER.—S. H. THOMPSON, Fort Myers, Fla. The invention relates to improvements particularly in reels and stretching mechanism for wire-fence construction in unwinding the wire in the building of a fence or reeling up the wire in taking down an old fence, the object being to provide a fence-machine so arranged that it may be quickly mounted on a wagon and as readily detached when not required for use.

PRESSWORK-RECORDER.—W. F. PALMER and J. WINNACOTT, New York, N. Y. The invention has reference to a device for recording the work of a printing-press and machines of a similar character. The principal objects of the improvement are to provide means for showing the theoretical number of papers produced and in connection therewith means for indicating when a web breaks.

APPARATUS FOR CLEANING ERASERS.—R. W. SHANNON and A. G. MILLIGAN, New Lexington, Ohio. In the present patent the improvement made by Messrs. Shannon and Milligan has reference to cleaning apparatus, and particularly to that adapted for cleaning erasers—as, for example, erasers used in connection with blackboards in schools. Its principal objects are to provide means for removing the dust from such articles and rendering them sterile.

DREDGING-MACHINE.—C. V. FOREMAN, Thurmont, Md. In this machine the dredging buckets are carried by a slide having movement on its carrying beam to adjust it both vertically and longitudinally of the beam for raising and lowering the buckets. The chains on which the buckets are mounted extend from the bottom of the slide up over sprocket wheels mounted on the end of the beam and after dumping into a tilting chute the chain of buckets is suitably guided beneath the chute back to the adjustable slide.

Prime Movers and Their Accessories.

VALVE.—S. A. PLOUGH, Traverse City, Mich. In this case the object is to provide a valve arranged to shut off the flow of fluid through the valve by the use of an emergency-valve whenever the main plug breaks or becomes out of order and to allow of conveniently removing the broken main plug for repairs or for replacing it by a new one and to permit resetting of the emergency-valve after the repairs are made to allow the use of the valve for its legitimate purpose.

Railways and Their Accessories.

UNLOADING APPARATUS.—J. E. KNIGHT, Blue Canyon, Wash. In this case the invention relates particularly to an apparatus for unloading logs from flat-cars, although it is useful in various other connections. The object of the improvement is to provide a convenient and inexpensive means for unloading logs, utilizing therefor the power of the locomotive of the train on which said logs may be loaded.

RACK CONSTRUCTION FOR REFRIGERATOR-CARS.—J. C. COLEMAN and E. W. KESSEL, El Paso, Texas. This invention is a rack construction particularly adapted for refrigerator-cars for the transportation of fruits or other produce in bulk, and so arranged and constructed that the racks can be run up next to the roof, out of the way, permitting the car to be used for produce or other freight not requiring the use of racks.

EXTENSION CAR-STEP.—B. WATSON, Eden, N. Y. One purpose of the invention is to provide an extension attachment for the fixed steps of car-platforms, which attachment is capable of ready and economic application to the fixed steps of any car or like vehicle. The extension-step can be quickly brought to its lower position as an extension from the main steps by a single movement of the trainman's foot on the platform and whereby the extension-step will be automatically carried to its upper or storage position as soon as unlocked from its lower position.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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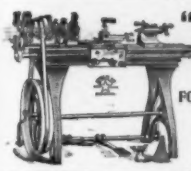

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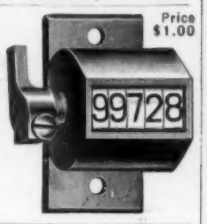

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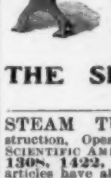

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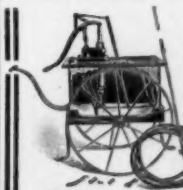

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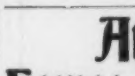

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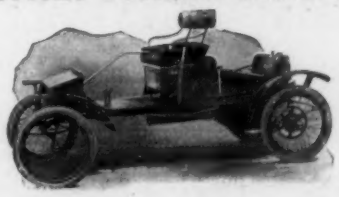

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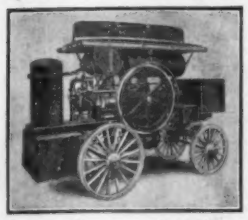
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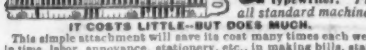
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Sausage filler, Koch Butchers' Supply Co.	56,352
Screw plates, taps, and dies, Champion Blower and Forge Co.	56,389, 56,390
Shade cloth, C. W. Breneman	56,387, 56,388
Silverware, sterling and solid, Rockford Silver Plate Co.	56,380
Tonic beverages and syrups therefor, J. A. Selby	56,382
Washing machines, lever, H. F. Brammer Manufacturing Co.	56,392
Washing machines, rotary, Benbow-Brammer Manufacturing Co.	56,386
Washing machines, rotary, H. F. Brammer Manufacturing Co.	56,391
Water, carbonated spring, Watertown Carbonating Co.	56,404
Whisky, Gooderham & Worts	56,368
Whisky, rye, Gilliams, Jones & Co.	56,366, 56,367

LABELS.

"Blank Border," for cigars, American Lithographic Co.	13,086
"Clearfield Orchard Company," for fruits, Clearfield Orchard Co.	13,090
"Good Old Dawson Rye Whisky," for whisky, S. Stearn	13,085
"Honest Weight Pure Flour," for flour, Honest Weight League	13,091
"King Abul," for cigars, Williams & Brenckle Cigar Manufacturing Co.	13,087
"Mosquito Lotion," for lotion, O. Steinhofer	13,088
"Thym-A-Tol Tooth Paste," for tooth paste, Thym-A-Tol Dental Co.	13,089
"Thym-A-Tol Flux," for soldering flux, Thym-A-Tol Dental Co.	13,092
"Union Butcher Manilla," for wrapping paper, Gray, Ewing & Co.	13,093

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"A Thousand Expert Cutters and Tailors," for men's and boys' coats, vests, and trousers, Ed. V. Price & Co.	1,794
"Adler's New Designs in Fall Fashions," for men's apparel, David Adler & Sons Clothing Co.	1,793
"College Brand Clothes, Fall and Winter Styles 1906-07," for clothes, E. L. Bilmine & Co.	1,798
"Gold Seal Brand Condensed Milk," for condensed milk, Borden's Condensed Milk Co.	1,788
"Men of the Widest Diversity of Taste," for men's and boys' coats, vests, and trousers, Ed. V. Price & Co.	1,796
"Men's Apparel," for men's apparel, W. C. Both	1,790 to 1,792
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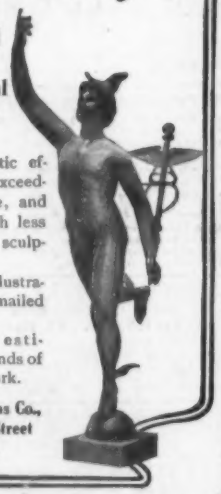

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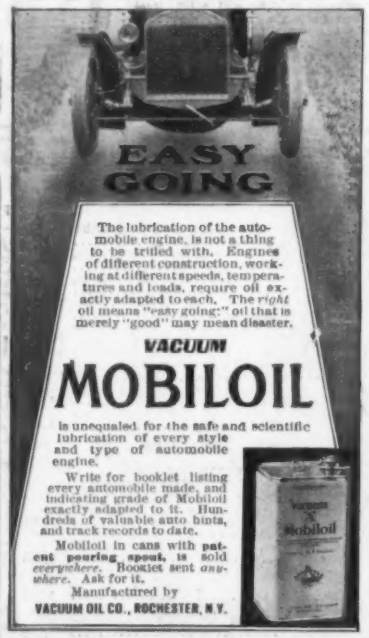

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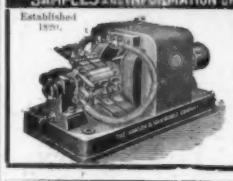

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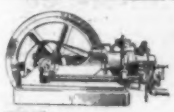

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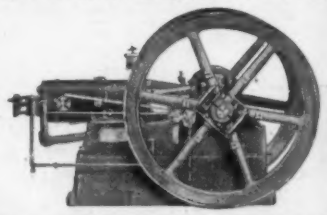

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